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ABSTRACT

This course of study in sheet metal work is intended as a teaching and learning guide and presents the basic skills needed for initial employment in sheet metal occupations. Introductory material includes an outline of general course objectives and corresponding activities to achieve the objectives, an instructional plan which suggests course length, use of the guide, teaching methods, vehicles of instruction, a bibliography of reference materials, and a listing of the titles of skill competency development jobs which correspond with specific job sheets in the body of the guide. The major portion of the guide consists of (1) job sheets, which indicate to the student what to do in performing the various jobs assigned by the instructor (sheets also include unit title, specific job title, material and equipment needed, and method of evaluation); and (2) operation sheets, which supplement the job sheets and indicate to the student how to perform the many skill competency operations necessary to complete the assigned jobs. Two sample sheets (information and assignment sheets) supplement the job sheets and are included to help the student complete the assigned jobs with the highest possible degree of understanding. (SH)

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ED150346

TRADE AND INDUSTRIAL EDUCATION

COURSE OF STUDY

FOR

SHEET METAL

COMPILED BY

Roger Keith
Jefferson County DuBois Area Vocational Technical School

Glenn King
A.W. Beattie Area Vocational Technical School

Thomas Sementelli
Lancaster County (Willow Street) Area Vocational Technical School

IN COOPERATION WITH

Division of Occupational and Vocational Studies
College of Education
The Pennsylvania State University

AND

Department of Education
Bureau of Vocational Education
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  John W. Struck, Director

Vocational Program Development Division
  T. Dean Witmer, Chief

Trade and Industrial Education
  John W. Brandt, Senior Program Specialist

Pennsylvania Department of Education
Box 911
Harrisburg, PA 17126

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PREFACE

In recent years, we have planned and constructed the finest of vocational education facilities and have placed fine equipment in these facilities. Equal attention must be directed to provide the teacher with the basic tools for instruction to assist in providing quality instruction.

This basic course of study is intended to be used as a teaching and learning guide. The information provides the essentials of the occupation, insuring that the students who successfully complete the course will have sufficient competencies for initial employment and ample orientation for growth and advancement. The teacher who uses this course may find it necessary to modify and supplement the material to meet the needs of specific students and the local industrial community.

This material has been prepared by a committee of teachers under the general direction of the staff of the Division of Occupational and Vocational Studies at The Pennsylvania State University in cooperation with the Trade and Industrial Education staff of the Bureau of Vocational Education of the Department of Education.

John W. Brandt

John W. Brandt
Senior Program Specialist
Trade and Industrial Education
Bureau of Vocational Education

1977

Frederick G Welch

Frederick G. Welch
Associate Professor, Project Director
Division of Occupational and Vocational Studies
The Pennsylvania State University

COURSE PHILOSOPHY

This course of study in sheet metal meets the needs of secondary students who seek specialized training in order to enter the labor market. Opportunities will be provided to encourage development of skill, knowledge and attitudes necessary for the student to function on the job, as well as enhance his citizenship qualities.

It is planned that each student may progress at a rate most appropriate for his background, desires and abilities. Those students showing leadership qualities will have the opportunity to exercise and develop those qualities. Group projects will be designed to encourage work cooperation and provide leadership functions. Safety on the job and safety in the design and fabrication of products will be a regular consideration. Pride and dignity of work accomplishments will be of utmost importance.

GENERAL COURSE OBJECTIVES

Objectives	Activities to Achieve Objectives
1. To develop specific skills and related knowledge associated with the occupation of sheet metal worker.	1. Series of individual jobs. 2. Practice exercises. 3. Series of group jobs. 4. Provide job sheets, operation sheets, information sheets, and assignment sheets for individual student use. 5. A portion of each session will be devoted to classroom instruction.
2. To develop an understanding of labor and management.	1. Assign reading in several trade magazines. 2. Arrange field trips. 3. Discussions on labor and management problems. 4. Present speakers from industry.
3. To develop good work habits and attitudes.	1. Provide specific standards for each work job. 2. Provide a clean, well-organized practice area conducive to learning. 3. Discuss importance of good work habits in relation to industrial practice, job advancement, etc. 4. Provide a means for students to plan their work accurately and methodically. 5. Measure students work objectively.
4. To develop safety habits and their value in sheet metal work.	1. Display safety posters. 2. Provide safety devices for all hazardous work. 3. Demonstrate correct safety practice when possible. 4. Show movies on safety. 5. Student safety committee will be actively involved in program.
5. To develop ability to work cooperatively with fellow workers.	1. Set up maximum of class and group projects. 2. Encourage students to seek help from each other. 3. Assign more advanced students to help students needing assistance. 4. A percentage of time will be spent in group activities.

Objectives	Activities to Achieve Objectives
6. To develop in each student the habits of self-reliance and resourcefulness.	1. Provide for students to design and plan some of their projects. 2. Provide a plan by which the student appraises his own work.

PLAN OF INSTRUCTIONAL PRACTICE

The effectiveness of instruction depends on the careful organization and control of the routine details concerning the management of the pupil, equipment, teaching methods and the physical laboratory arrangement. The teacher must determine the best management practices and formulate a very definite statement of the basic standards to be followed in teaching the course to bring about the attainment of the learning goals.

Length of Course

The course of study is designed as a three-year curriculum involving approximately 1500 hours of class and laboratory instruction, primarily for beginning students who are interested in securing employment in the occupation. Where job entry is the goal, the entire course of study would be appropriate. In adults programs, it may be found that a single thrust is the student's goal, therefore, the course content may be restricted to a single major division.

Use of This Course of Study

The material has been arranged in major divisions of the trade. In most cases, the material contained in the first division must be learned before progressing to the next division. The nature of some trade areas permit entry into random divisions after the introductory basic material is covered. Some divisions of the occupation can be taught separately.

The content of this course material consists of job sheets (yellow) and skill competency sheets (white). The skill competency sheets are simply written and highly illustrated. These sheets outline the manipulative handling of tools and materials that make up the doing part of the occupation. The sequence of the skill competency sheets (SC) is based on the organization of the job sheets. Notice that job number one incorporates the basic skill competencies and job number two includes additional skill competencies. This cumulative reuse of the skill competencies continues throughout the entire job sheet collection. After a number of jobs have insured that the student has been sufficiently exposed to a skill competency, no further reference to that skill competency is made.

The job sheets are arranged in an order that gradually exposes the skill competencies. The purpose of the job sheet is to insure the introduction of each operation or skill competency in a controlled manner. Look at this group of jobs as a framework that can be added to, by you, to meet local needs. You may decide to design new or different jobs that will be inserted between or replace any of the suggested jobs. In time you will be able to custom design a course of study for your own needs. There will be little or no need to vary the skill competency sheets.

Teaching Methods

The following procedures are offered as the most productive in achieving the desired results in this course.

1. Demonstrations--Operations and procedures will be demonstrated while the students observe. The purpose is to show how things are done correctly and safely.

2. Class Discussion--A method of teaching in which the students and the teacher take part, directed and controlled by the teacher to a predetermined objective. Technical and related information common to a class or group of students will be presented in this manner. Evaluation of the material presented in this manner should be done by objective testing.

3. Laboratory Talks--Short, informal talks by the instructor during laboratory activities to convey information pertinent to the activity in progress. Not scheduled and not timed, this activity should occur at any appropriate time and for periods of varying duration.

4. Observation and Input--This teacher activity should take place at all times when students are performing psychomotor skills. The purpose is to reinforce a previously given demonstration, class discussion, or laboratory talk, or to update the students' skills by further demonstration and/or further disclosures of technical and related information.

Vehicles of Instruction

The application phase of this course will consist of work assignments kept as close to industrial conditions as a shop situation permits. Job, operation and information sheets will be provided, so that students of different levels of skill and ability can understand them. The students will be encouraged to progress as rapidly as possible, and achieve the standard set for the course. Special attention will be given to the unique student, offering special assistance so that slow as well as fast students may progress at their own rate of speed.

Items to Be Developed by Local Teacher

The following items are peculiar to the local school situation and need to be developed by each local instructor.

- Standards of attainment required
- Pupil work evaluation
- Shop controls and regulations
- Pupil personnel organization
- Method of tool check
- Records and forms

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COURSE OUTLINE

Instructional Title: Sheet Metal Code: 17.2305

OCCUPATIONAL DESCRIPTION

Specialized classroom and shop experiences concerned with the layout, fabrication, erection or installation, and maintenance of items made of steel, copper, stainless steel, and aluminum, such as ventilating air conditioning and heating ducts, kitchen equipment, signs, furniture, and skylights. Instruction includes the use of handtools and machines, such as the cornice brake, forming rolls and squaring shears; drafting; and blueprint reading.

MAJOR DIVISIONS OF THE OCCUPATION

I. Orientation

II. Drafting

III. Hand Tools and Machines

IV. Welding

V. Duct Fittings

VI. Installation

SKILL COMPETENCY DEVELOPMENT JOBS

These are suggested typical jobs to provide experiences to assist the student to learn the skill competencies of the occupation. These are job titles only--the numbers preceding each title correspond with the identifying numbers found on the JOB SHEETS which follow:

UNIT I. ORIENTATION

UNIT II. DRAFTING

J-2-1	Fasten Paper to Board
J-2-2	Draw Horizontal Lines
J-2-3	Draw Verticle Lines
J-2-4	Draw Two Squares and Two Rectangles
J-2-5	Draw Four Circles
J-2-6	Draw Hexagon
J-2-7	Draw Octagon
J-2-8	Draw Pentagon
J-2-9	Draw an Ellipse
J-2-10	Draw Angles

UNIT III. HAND TOOLS AND MACHINES

J-3-1	Obtain Material
J-3-2	Measure and Mark Plate
J-3-3	Prick Mark a Plate
J-3-4	Lay Out Parallel Lines
J-3-5	Cut Parallel Lines
J-3-6	Remove Sharp Edge
J-3-7	Fabricate a Square Plate
J-3-8	Fabricate Rectangular Plate
J-3-9	Fabricate a Single Hem
J-3-10	Groove Seam a Plate

J-3-11	Fabricate a Square Tube
J-3-12	Fabricate a Hexagonal Plate
J-3-13	Fabricate a Hexagonal Tube
J-3-14	Fabricate an Octagonal Plate
J-3-15	Fabricate a Pentagonal Plate
J-3-16	Fabricate a Hanger
J-3-17	Fabricate a Rectangular Plate
J-3-18	Fabricate a Pipe Hanger
J-3-19	Fabricate Two Square Pans
J-3-20	Fabricate a Square Container
J-3-21	Fabricate a Pentagonal Container
J-3-22	Fabricate Round Pipe
J-3-23	Burr Two Ends For J-3-22
J-3-24	Fabricate Two End Caps for J-3-23
J-3-25	Assemble J-3-22 and J-3-23
J-3-26	Form a Double Seam on J-3-25
J-3-27	Make a Round Cup
J-3-28	Make a Round Bank
J-3-29	Make a Round Dipper
J-3-30	Make a Cone
J-3-31	Fabricate a Frustum of a Cone
J-3-32	Make a Funnel
J-3-33	Make Measuring Cup
J-3-34	Make a Tool Box
J-3-35	Make a Discharge Stack and Hood
J-3-36	Fabricate a Two Piece 45° Elbow
J-3-37	Make a Round Offset
J-3-38	Make a Three Piece Elbow

J-3-39	Fabricate a Taper Square to Round "T"
J-3-40	Make a Metal Chute

UNIT IV. WELDING

J-4-1	Transport Oxy-Acetylene Cylinders
J-4-2	Set up Gas Weld Equipment
J-4-3	Close Oxygen Acetylene Equipment
J-4-4	Clean and Select Tip
J-4-5	Light and Adjust Torch
J-4-6	Cut a Plate
J-4-7	Weld Name on Plate
J-4-8	Edge Weld
J-4-9	Weld a Corner Joint
J-4-10	Weld a Corner Joint
J-4-11	Weld a Butt Joint
J-4-12	Weld a Lap Joint
J-4-13	Weld a T-Fillet Weld
J-4-14	Weld a Vertical Butt Joint
J-4-15	Weld an Overhead Butt Joint
J-4-16	Weld a Lap Joint, Overhead Weld
J-4-17	Weld a T-Fillet, Overhead Weld
J-4-18	Braze Beads
J-4-19	Braze Butt Joints
J-4-20	Braze a Lap Joint
J-4-21	Braze a T-Joint
J-4-22	Cut Pipe
J-4-23	Ream Pipe
J-4-24	Thread Pipe
J-4-25	Make a Drip Pan

J-4-26	Attach and Light a Cutting Torch
J-4-27	Flame Cut Scrap Metal
J-4-28	Make a Square Offset
J-4-29	Make a Round Offset Joint
J-4-30	Make a Square Transition
J-4-31	Fabricate a Taper Square Intersecting a Round Pipe
J-4-32	Fabricate a Round Tee
J-4-33	Fabricate a Round "Y" Branch
J-4-34	Fabricate a Round Pipe Intersecting a Round Transition
J-4-35	Make a Square-to-Round Duct

UNIT V. DUCT FITTINGS

J-5-1	Form a Pittsburgh Lock on the Brake
J-5-2	Form a Pittsburgh Lock on the Lock Former
J-5-3	Make a Square Duct
J-5-4	Make Two Rectangular Ducts
J-5-5	Fabricate an S-Cleat
J-5-6	Fabricate a Drive Cleat
J-5-7	Use J-5-5 and J-5-6 and Connect the Two Ducts in J-5-4
J-5-8	Fabricate a 90° Rectangular Duct Elbow
J-5-9	Make a 90° Rectangular Duct Elbow Radius Heal
J-5-10	Fabricate a 90° Rectangular Duct Elbow Radius Throat and Heel
J-5-11	Fabricate a 45° Rectangular Duct Square Throat and Heel
J-5-12	Fabricate a 45° Rectangular Duct Radius Throat and Heel
J-5-13	Fabricate a 45° Brodway Elbow
J-5-14	Make a 90° Brodway Elbow
J-5-15	Make a Square Duct Tap
J-5-16	Make a Round Duct Tap
J-5-17	Fabricate a Rectangular Transition Duct Tap

J-5-18	Make a Rectangular Transition Duct Tap (Sweep)
J-5-19	Make a Register Box
J-5-20	Fabricate a Y-Branch
J-5-21	Fabricate a Y-Branch Offset
J-5-22	Assemble Two Ducts to J-5-21
J-5-23	Make a Rectangular Transition
J-5-24	Make a Rectangular Transition
J-5-25	Make a Rectangular Transition
J-5-26	Make a Transition Y-Branch
J-5-27	Make a Change Transition
J-5-28	Make a Change Transition
J-5-29	Make a 45° Twist
J-5-30	Make a Twist and Offset Duct Fitting
J-5-31	Make an Offset Duct Fitting
J-5-32	Make an Offset Duct Fitting
J-5-33	Make a Change Offset
J-5-34	Make a Change Elbow
J-5-35	Make a Change Elbow
J-5-36	Make a Transition Change Elbow
J-5-37	Fabricate a Two-in-One Elbow

UNIT VI. INSTALLATION

J-6-1	Cut a Hole in a Concrete Block
J-6-2	Install a Bracket
J-6-3	Cut Kerf for Flashing
J-6-4	Install Flashing
J-6-5	Level a Furnace
J-6-6	Rough-in A Register
J-6-7	Install a Plenum

SKILL COMPETENCIES AND INFORMATION LESSONS

The left hand column lists the tasks or operations workers perform in the occupation which form the SKILL COMPETENCIES required of the student. These competencies should be demonstrated by the teacher and practiced by the student.

The INFORMATION LESSONS outline the general technical information and knowledge needed to perform the skill competencies. These items represent the common information taught on a group instruction basis. Additional information will emerge to be taught on an individual student basis as pupils work on the skill competencies.

The numbers preceding each title correspond to the identifying numbers of the operation sheets and the information sheets. The information lessons relate to the particular major unit of instruction but do not necessarily relate to corresponding skill competency numbers.

UNIT I. ORIENTATION

SKILL COMPETENCIES/OPERATIONS The student will be able to:	INFORMATION LESSONS	
	IL-1-1	History and Ethics of the Trade
	IL-1-2	Shop Regulations and Procedures
	IL-1-3	Identification of Hand Tools
	IL-1-4	Shop Safety
	IL-1-5	Trade Hygiene
	IL-1-6	Trade Materials
	IL-1-7	Trade Math
	IL-1-8	Blueprint Reading
	IL-1-9	Identification of Machines and Equipment

UNIT II. DRAFTING

SKILL COMPETENCIES/OPERATIONS The student will be able to:	
SC-2-1	Position and Move a T-Square
SC-2-2	Place Paper on Drawing Board
SC-2-3	Place a Measurement on Paper
SC-2-4	Use Triangles
SC-2-5	Use a Drafting Compass
SC-2-6	Use Drafting Dividers
SC-2-7	Use a Scaling Rule
SC-2-8	Use a Protractor

INFORMATION LESSONS	
IL-2-1	Types of Parallel Bars, T-Squares, and Straight Edges
IL-2-2	Required Tools for a "Standard" Tool Kit
IL-2-2A	Safety in the Drafting Room
IL-2-2B	Care and Maintenance of Drafting Equipment
IL-2-2C	Understanding the Principles of Architectural Drafting
IL-2-3	Types of Scales
IL-2-4	Understanding and Identifying Types of Angles
IL-2-5	Understanding and Identifying Parts of a Circle
IL-2-6	Care of Drafting Instruments
IL-2-7	Understanding the Various Architectural Drawings
IL-2-8	Various Methods of Measuring Angles
IL-2-9	Understanding and Identifying Types of Polygons
IL-2-10	Determine the Commonly Used Trade Symbols
IL-2-11	Types and Uses of Geometric Constructions
IL-2-12	Types of Irregular Curves

UNIT III. HAND TOOLS AND MACHINES

SKILL COMPETENCIES/OPERATIONS The student will be able to:	
SC-3-1	Measure Sheet Metal with Metal Gage
SC-3-2	Measure Using a Micrometer
SC-3-3	Mark with a Pencil, Soap Stone Chalk or Scribe
SC-3-4	Mark Metal with a Prick or Center Punch
SC-3-5	Scribe a Line with a Scratch Awl and a Straight Edge
SC-3-6	Make a Straight Cut With Straight, Combination or Bulldog Snips
SC-3-6A	Cut an Inside Square with Aviation Shears
SC-3-6B	Make an Inside Curved Cut with Hand Shears
SC-3-6C	Cut Outside Curved Cuts With Combination Shears
SC-3-6D	Cut Wire with Side Cutters or Diagonals
SC-3-6E	Notch Metal
SC-3-7	Smooth and Shape Metal Using a File
SC-3-8	Lay Out a Square Line on Stock
SC-3-9	Shear Metal on Squaring Shear Using Side and Back Gage
SC-3-9A	Shear to Reference on Squaring Shear without Gages
SC-3-10	Bend Metal on the Cornice Brake

INFORMATION LESSONS	
IL-3-1	Understanding Metal Thickness by Gage
IL-3-2	Types and Sizes of Sheet Metal
IL-3-4	Punches; Types and Construction
IL-3-4A	Factors Determining Punch Sizes
IL-3-6	Types, Care and Use of Hand Snips
IL-3-6A	Types and Sizes of Commonly Used Wire
IL-3-6B	Types and Sizes of Notches
IL-3-7	Types, Care and Use of Files
IL-3-8	Selecting the Proper Layout Method
IL-3-8A	Care and Use of Layout Tools
IL-3-9	Factors Determining Use of Squaring Shear
IL-3-9A	Squaring Shears; Types and Selection
IL-3-9B	Make Adjustments on the Squaring Shear
IL-3-10	Brakes; Types and Construction
IL-3-10A	Determining Minimum Flanges Which Can Be Formed on Brakes
IL-3-10B	Determining Proper Bending Sequence on Brakes
IL-3-10C	Make Adjustments on Cornice Brake
IL-3-11	Hand Seaming with Groovers
IL-3-12	Folding Equipment, Materials and Methods

SKILL COMPETENCIES/OPERATIONS
The student will be able to:

SC-3-11	Form an Outside Grooved Seam
SC-3-12	Form Metal on the Bar Folder
SC-3-13	Scribe Arcs with Dividers or Compass
SC-3-14	Tin a Soldering Copper
SC-3-14A	Solder a Seam With a Soldering Iron
SC-3-15	Punch Holes with Hand Punch
SC-3-16	Rivet with a Rivet Set
SC-3-16A	Rivet with a Pop Rivet Gun
SC-3-17	Hold Materials with "C" Clamps
SC-3-17A	Hold and Tighten with a Rib Lock Plier
SC-3-18	Notch Metal on the Coper Notcher Shears
SC-3-19	Cut Metal with a Hack Saw
SC-3-20	Put Drill Bit into a Drill Motor Chuck
SC-3-20A	Drill Holes in Sheet Metal with the Hand Electric Drill
SC-3-21	Bend Sides on a Box or Pan on the Box and Pan Brake
SC-3-22	Punch Holes in Metal on Turret Punch
SC-3-23	Spot Weld Metal on the Spot Welder

INFORMATION LESSONS

IL-3-12A	Bar Folders; Types and Construction
IL-3-12B	Various Edges and Folds That Can be Formed on Bar Folders
IL-3-12C	Make Adjustments on the Bar Folder
IL-3-14	Types and Sizes of Soldering Coppers
IL-3-14A	Types and Sizes of Solders
IL-3-14B	Types and Sizes of Soldering Fluxes
IL-3-14C	Types of Soldering Copper Heating Equipment
IL-3-14D	Forging and Tinning a Soldering Copper
IL-3-14E	Types of Dipping Solutions
IL-3-14F	Soldering Metals of Different Types
IL-3-15	Types, Use and Care of Hand Punches
IL-3-16	Types, Sizes and Use of Rivets
IL-3-16A	Care and Use of The Hand "Pop" Rivet Gun
IL-3-16B	Selecting Proper Rivet Sizes
IL-3-16C	Types and Sizes of Rivets
IL-3-17	Drill Holding Devices
IL-3-18	Coper, Notcher Shear; Types and Construction
IL-3-18A	Factors Determining Use of Coper Notcher Shear
IL-3-18B	Make adjustments on the Coper Notcher Shear

SKILL COMPETENCIES/OPERATIONS
The student will be able to:

SC-3-24	Form Cylindrical Shapes on the Slip Roll Forming machine
SC-3-25	Burr an Edge on the Burring Machine
SC-3-26	Shear Circular Shapes on Ring and Circle Shears
SC-3-26A	Make Irregular Cuts on Ring and Circle Shear
SC-3-27	Set Down a Single Seam with the Setting Down Machine
SC-3-28	Form a Double Seam on the Double Seaming Machine
SC-3-28A	Form a Double Seam on Stakes Using a Mallet
SC-3-29	Assemble a Wired Edge on Stakes Using Pliers and Setting Down Hammer
SC-3-30	Measure Using Inside Calipers
SC-3-31	Form Beads with the Combination Rotary Machine
SC-3-32	Measure Using Outside Calipers
SC-3-33	Cut Metal on the Band Saw
SC-3-34	Form Round Tapers on Bench Stakes by Hand
SC-3-34A	Form a Transition on Stakes with Mallet
SC-3-35	Roll Tapered Shapes on the Slip-Roll Forming Machine

INFORMATION LESSONS

IL-3-19	Care and Use of the Hand Hack Saw
IL-3-20	Use and Care of Hand Drills
IL-3-21	Make Adjustments on Box and Pan Brake
IL-3-24	Roll Forming Machines; Types and Construction
IL-3-24A	Factors That Determine Selections of Roll Forming Machine
IL-3-26	Make Adjustments on Ring and Circle Shear
IL-3-27	Make Adjustments on the Setting Down Machine
IL-3-28	Make Adjustments on Double Seaming Machine
IL-3-31	Rotary Machines; Types and Construction
IL-3-31A	Factors Determining Selection of Proper Rotary Machine for the Job Required
IL-3-31B	Make Adjustments on Combination Rotary Machine
IL-3-32	Types and Sizes of Calipers
IL-3-33	Band Saw; Types and Construction
IL-3-33A	Factors Determining Blade Selection
IL-3-33B	Factors Determining Sawing Speeds
IL-3-34	Types, Care and Use of Bench Stakes
IL-3-35	Make Adjustments on the Slip Roll

SKILL COMPETENCIES/OPERATIONS The student will be able to:	
SC-3-36	Form Metal on the Turning Machine
SC-3-37	Shear Metal with the Unishear
SC-3-38	Drill Holes in Metal on the Drill Press
SC-3-39	Adjust and Use an Adjustable Wrench
SC-3-39A	Tighten and Loosen Fasteners with Allen Wrenches
SC-3-39B	Tighten Pipes and Fittings With Pipe Wrenches
SC-3-39C	Use a Socket Wrench With a Breaker Bar
SC-3-39D	Use Combination Wrenches
SC-3-40	Tighten and Loosen Screws with a Flat Screwdriver
SC-3-41	Cut Internal Threads Using the Tap
SC-3-42	Form an Elbow Lock with a Combination Rotary Machine
SC-3-43	Crimp Metal with a Combination Rotary Machine
SC-3-44	Offset Metal on the Combination Rotary Machine

INFORMATION LESSONS	
IL-3-36	Make Adjustments on the Turning Machine
IL-3-37A	Make Adjustments on Punch Press
IL-3-38	Drill Press; Types and Construction
IL-3-38A	Determining Proper Drill Speed
IL-3-38B	Descriptions and Use of Cutting Compounds
IL-3-38C	Personal Safety in Using The Drill Press
IL-3-39	Common Bench Tools
IL-3-41	Care and Use of Taps and Dies
IL-3-45	Understanding Trade Terms
IL-3-46	Determining the Most Economical Cut From a Sheet of Metal
IL-3-47	Types and Sizes of Seams
IL-3-47A	Allowance of Seams
IL-3-48	Types and Sizes of Edges and Stiffners
IL-3-48A	Allowance of Edges and Stiffners
IL-3-49	Types and Sizes of Bar Stock
IL-3-50	Understanding the Principles of Orthorgraphic Projection
IL-3-51	Understanding the Principles of Isometric Views
IL-3-52	Bench Lever Shears; Types and Construction
IL-3-53	Types and Sizes of Sheet Metal

SKILL COMPETENCIES/OPERATIONS The student will be able to:	INFORMATION LESSONS	
	IL-3-54	Uses of Different Types of Sheet Metal
	IL-3-55	Bolts Commonly Used in the Sheet Metal Shop
	IL-3-56	Types and Sizes of Sheet Metal Screws
	IL-3-57	Understanding the Principles of Elevation Views
	IL-3-58	Proper Storage and Handling of Sheet Metal
	IL-3-59	Understanding Detailed Drawings
	IL-3-60	Understanding Sectional Views
	IL-3-61	Procedures for Transferring Patterns
	IL-3-62	Understanding the Principles of Plan View
	IL-3-63	Identifying True Lengths
	IL-3-64	Development and Use of Specifications
	IL-3-65	Principles of Right Triangles
	IL-3-66	Principles of Plane Surfaces
	IL-3-67	Use of Layout Mathematics
	IL-3-68	Principles of Geometry

UNIT IV. WELDING

SKILL COMPETENCIES/OPERATIONS The student will be able to:	
SC-4-1	Transport Acetylene and Oxygen Cylinders
SC-4-2	Set Up Gas Welding Equipment
SC-4-3	Close the Oxy-Acetylene Equipment
SC-4-4	Clean Cutting or Welding Tips with a Tip Cleaner
SC-4-5	Open the Oxy-Acetylene Equipment for Welding
SC-4-6	Light and Adjust the Torch and Flame
SC-4-7	Shear Metal on the Bench Lever Shear
SC-4-8	Join Metal by Fusion Welding with Oxy-Acetylene Torch
SC-4-9	Use the Portable Disc Sander
SC-4-10	Braze with Oxygen and Acetylene Torch
SC-4-11	Cut Pipe
SC-4-12	Ream a Pipe
SC-4-13	Thread a Pipe Using Pipe Dies
SC-4-14	Attach and Light a Cutting Torch
SC-4-15	Pierce Holes with a Cutting Torch
SC-4-15A	Flamecut with a Hand Torch
SC-4-16	Grind Metal on Bench Grinder

INFORMATION LESSONS	
IL-4-1	Proper Handling and Storage of Cylinders
IL-4-2	Types and Sizes of Welding Machines
IL-4-2A	Oxygen and Acetylene Cylinders; Types and Sizes
IL-4-2B	Types and Sizes of Oxy-Acetylene Hose
IL-4-2C	Proper Care of Oxy-Acetylene Hoses
IL-4-2D	Proper Methods for Connecting Oxy-Acetylene Equipment
IL-2-4E	Safety; Prevention of Backfire and Flashback with Oxy-Acetylene Equipment
IL-4-4	Types and Sizes of Cleaning Equipment a. chipping hammers b. wire brushes
IL-4-4A	Types and Sizes of Welding Tips
IL-4-4B	Proper Care of Torches and Tips
IL-4-5	Proper Methods for Leakage Detection
IL-4-6	Types and Sizes of Regulators
IL-4-6A	Proper Care of Regulators
IL-4-6B	Make Adjustments on the Oxygen-Acetylene Torch
IL-4-7	Bench Lever Shears; Types and Construction
IL-4-7A	Make Adjustments on the Bench Lever Shear
IL-4-8	Types of Gas--Shielded Arc Processes

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SKILL COMPETENCIES/OPERATIONS The student will be able to:	
SC-4-17	Strike an Arc and Run a Bead
SC-4-18	Strike an Arc and Run a Fusion Bead with T.I.G. Welder
SC-4-19	Assemble by Fusion Welding with the M.I.G. Welder

INFORMATION LESSONS	
IL-4-10	Types of Welding, Brazing and Cutting Flames
IL-4-14	Types and Sizes of Torches
IL-4-14A	Types and Sizes of Cutting Tips
IL-4-15	Safety for Oxy-Acetylene Welding and Cutting
IL-4-16	Grinders; Types and Construction
IL-4-16A	Grinding Wheels; Types and Sizes
IL-4-16B	Factors Determining Selection of Grinding Wheels
IL-4-16C	Make Adjustments on Bench Grinder
IL-4-17	Understanding the Welding Symbols as Applied to Sheet Metals
IL-4-17A	Electrical and Welding Terms
IL-4-17B	Types of Welded Joints
IL-4-18	Types of Welding Current
IL-4-18A	Electrode Selection
IL-4-18B	Electrode Classification: a. A.W.S. b. N.E.M.A.
IL-4-18C	Factors Determining Use of the T.I.G. Welder
IL-4-18D	Types and Sizes of Gas Cups and Collect Adapters
IL-4-18E	Types and Sizes of Remote Current Control Switches
IL-4-18F	Types and Sizes of T.I.G. Torches

SKILL COMPETENCIES/OPERATIONS The student will be able to:	INFORMATION LESSONS	
	IL-4-18G	Types, Sizes and Shapes of Tungsten Electrodes
	IL-4-18H	Make Adjustments on the T.I.G Welder
	IL-4-19	Types and Sizes of Electrodes and Holders
	IL-4-19A	Conserving and Storing Electrodes
	IL-4-19B	Controlling Distortion--Warpage
	IL-4-19C	Factors Determining Use of the M.I.G. Welder
	IL-4-19D	Types of Metal Transfer on M.I.G.
	IL-4-19E	Types and Sizes of Wire Feeding Mechanisms
	IL-4-19G	Types and Sizes of M.I.G. guns
	IL-4-19H	Types and Sizes of Wire Electrodes
	IL-4-20	Factors Determining Metal Distortion
	IL-4-21	Metallurgy of Sheet Metals
	IL-4-22	Care and Use of Personal Equipment a. Helmet d. Apron & Cape b. Safety Glasses e. Goggles c. Gloves f. Beanie
	IL-4-23	Types and Sizes of Cables and Ground Clamps
	IL-4-24	Safety - Personnel and Shop

SKILL COMPETENCIES/OPERATIONS The student will be able to:		INFORMATION LESSONS
	IL-4-25	Types and Sizes of Jigs and Fixtures
	IL-4-26	Types of Inert Gasses
	IL-4-27	Inert Gas Selection
	IL-4-28	Methods of Joint Preparation
	IL-4-29	Common Weld Defects
	IL-4-30	Types and Sizes of Filler Rods
	IL-4-31	Preparation of Base Metals
	IL-4-32	Safety - Protective Clothing
	IL-4-33	Make Adjustments on an AC-DC Welder

UNIT V. DUCT FITTINGS

SKILL COMPETENCIES/OPERATIONS
The student will be able to:

SC-5-1	Form a Pittsburgh Lock in the Brake
SC-5-2	Assemble a Pittsburgh Lock
SC-5-3	Form a Pittsburgh Lock on a Lock Former
SC-5-4	Form Cleats on the Cleat Bender
SC-5-5	Make "S" Cleats
SC-5-6	Make Drive Cleats
SC-5-7	Assemble a Duct with "S" and Drive Clips
SC-5-8	Form Metal on a Cross-brake
SC-5-9	Form a Flange on the Easy Edger
SC-5-10	Cut Metal on the Shop Master Unit
SC-5-11	Notch Metal on the Power Notching Unit
SC-5-12	Cut with Hand Nibbler
SC-5-13	Cut a Starting Slit for an Inside Cut with Hammer and Chisel
SC-5-14	Assemble a Tap Lock into a Duct
SC-5-15	Assemble a Hooked Edge

INFORMATION LESSONS

IL-5-3	Lock Forming Machines; Types and Construction
IL-5-3A	Factors Determining Use of Lockformer
IL-5-3B	Make Adjustments on the Lockforming Machine
IL-5-3C	Form Pittsburgh Lock on the Lockforming Machine
IL-5-4	Cleat Bender; Types and Construction
IL-5-10	Shopmate Types and Construction
IL-5-10A	Factors Determining Use of the Shopmate
IL-5-10B	Make Adjustments on the Shopmate Unit
IL-5-11	Types and Sizes of Notches
IL-5-12	Use and Care of Hand Nibblers
IL-5-13	Types, Use and Care of Chisels
IL-5-15	Types and Sizes of Seams
IL-5-15A	Types and Sizes of Edges and Stiffners
IL-5-15B	Allowance of Seams
IL-5-16	Principles of "Short Cut" Layout Methods
IL-5-17	Determining the Most Economical Cut From a Sheet of Metal
IL-5-18	Interpreting Ductwork Notations
IL-5-19	Recognize the Standard Abbreviations Used on Ductwork

UNIT VI. INSTALLATION

SKILL COMPETENCIES/OPERATIONS
The student will be able to:

SC-6-1	Cut with a Star Chisel
SC-6-2	Using the Hammer Drill
SC-6-3	Cut with the Mortar Saw
SC-6-4	Fold Metal with Hand Tongs
SC-6-5	Use a Caulking Gun
SC-6-6	Level
SC-6-7	Cut with a Sawzall
SC-6-8	Drive Nails
SC-6-8A	Pull Nails
SC-6-9	Drive a Screw with an Electric Drill
SC-6-10	Mark a Long Line using a Chalk Line
SC-6-11	Take Outside Measurements
SC-6-12	Take Inside Measurements

INFORMATION LESSONS

IL-6-1	Methods of Cutting Openings in House for Duct Work
IL-6-1A	Types and Sizes of Star Chisels
IL-6-2	Types and Sizes of Hammer Drills
IL-6-2A	Proper Adjustment and Set Up of Hammer Drills
IL-6-3	Methods of Cutting Wall Openings
IL-6-3A	Types and Sizes of Circular Saws
IL-6-3B	Proper Adjustment and Set Up of Circular Saws
IL-6-4	Types and Sizes of Hand Tongs
IL-6-5	Types and Uses of Caulking
IL-6-6	Types, Care and Use of Levels
IL-6-6A	Proper Maintenance and Care of Levels
IL-6-7	Proper Maintenance and Care of Sawzalls
IL-6-7A	Proper Adjustment and Set Up of Sawzalls
IL-6-8	Methods of Installing Flashing
IL-6-8A	Types and Uses of Nails
IL-6-9	Types and Uses of Screw Drills
IL-6-10	Types and Sizes of Chalk Lines
IL-6-11	Gas Pipe Sizing
IL-6-12	Oil Pipe Sizing

SKILL COMPETENCIES/OPERATIONS The student will be able to:		INFORMATION LESSONS
	IL-6-13	Locating Furnaces
	IL-6-14	Wiring Code
	IL-6-15	Plumbing Code
	IL-6-16	Types of Vents
	IL-6-17	Amount of Air Needed for Combustion
	IL-6-18	Code for Fuel Tanks
	IL-6-19	Types of Control Installation
	IL-6-20	Method of Panning Joists
	IL-6-21	Types of plenums
	IL-6-22	Reducing Trunk Duct System
	IL-6-23	Extended Plenum System
	IL-6-24	Perimeter Loop System
	IL-6-25	Perimeter Radial System
	IL-6-26	Overheat Distrubution System
	IL-6-27	Types of Dampers
	IL-6-28	Types of Diffusers
	IL-6-29	Types of Return Air Grills
	IL-6-30	Locating Fresh Air Intake
	IL-6-31	Types of Duct Insulation
	IL-6-32	Use of Air Flow Meter
	IL-6-33	Method of Cutting Roof Curbs
	IL-6-34	Methods of Installing Roof Curbs
	IL-6-35	Types of Weather Sealing
	IL-6-36	Motor Protection

SKILL COMPETENCIES/OPERATIONS The student will be able to:		INFORMATION LESSONS
	IL-6-37	Types of Thermostats
	IL-6-38	Types of Filters
	IL-6-39	Types of Blowers
	IL-6-40	Types of Pressure Gages
	IL-6-41	Burner Flame Adjustments
	IL-6-42	Types of Pilot Burners
	IL-6-43	Types of Pilotstats
	IL-6-44	Types of Warm Air Controls
	IL-6-45	Types of Gas Valves
	IL-6-46	Types of Fan Controls
	IL-6-47	Types of Zone Controls
	IL-6-48	Types of Oil Primary Controls
	IL-6-49	Types of Oil Burners
	IL-6-50	Types of Ignition Systems
	IL-6-51	Types of Flame Detectors
	IL-6-52	Electrical Wire Sizing
	IL-6-53	Mathematics for Calculating Areas
	IL-6-54	Mathematics for Calculating Volumes
	IL-6-55	Mathematics for Calculating Vacuum
	IL-6-56	Determining Material Loss
	IL-6-57	Basic Principles for Heating and Cooling
	IL-6-58	How Heat Is Measured
	[illegible]6-59	How Our Bodies Gain and Lose Heat

SKILL COMPETENCIES/OPERATIONS The student will be able to:	INFORMATION LESSONS	
	IL-6-60	When You Are Comfortable
	IL-6-61	Heat Flow in Ducts
	IL-6-62	Gains and Losses of Heat
	IL-6-63	Heat Loss and Heat Gain in Buildings
	IL-6-64	Heat Loss and Heat Gain Circulation Procedures
	IL-6-65	Perimeter Heating and Cooling
	IL-6-66	Continuous Air Circulation
	IL-6-67	Humidity Control
	IL-6-68	Vibration and Sound Control
	IL-6-69	Distributing Air for Comfort
	IL-6-70	Factors in Room Air Distribution
	IL-6-71	Flow Patterns of Vertical Discharge Outlets
	IL-6-72	Flow Patterns of Horizontal Discharge Outlets
	IL-6-73	Selecting the Proper Outlet
	IL-6-74	Types of Air Distribution Systems
	IL-6-75	Special Considerations for Zoning
	IL-6-76	Design Procedure for Individual Duct Systems Located in Air or Radial Duct Systems in Slab
	IL-6-77	Design Procedure for Trunk and Branch Duct System
	IL-6-78	Design Procedure for Perimeter Loop Duct System

SKILL COMPETENCIES/OPERATIONS The student will be able to:	INFORMATION LESSONS	
	IL-6-79	Design Procedures for Crawl Space Plenum System
	IL-6-80	Design Procedures for Return Air Duct System
	IL-6-81	Procedures for Calculating Air Friction
	IL-6-82	Procedures for Calculating Proper Ventilation
	IL-6-83	Types and Sizes of Abrasive Cutting Wheels

WRITTEN INSTRUCTIONAL AIDS

Introduction

Instruction sheets are aids used in developing the most effective and efficient teaching-learning situation that is possible. Four types of sheets are generally used including job sheets, operation sheets, information sheets and assignment sheets.

JOB SHEETS indicate to the student what to do in performing the various jobs assigned by the instructor. The jobs that will be used as vehicles of instruction in the course are listed in the COURSE OUTLINE section.

The job involves a sequential performance of operations by the learner to "tryout" and develop the skill competencies (operations) of the occupation resulting in a product or service. It is the vehicle of instruction or the media by which the student practices and develops a series of skill competencies (operations).

OPERATION SHEETS supplement the job sheets and indicate to the student how to perform the many skill competency operations necessary to complete the assigned jobs. The operations that will be taught in the course are listed in the COURSE OUTLINE section under skill competencies/operations. The operation sheets should be numbered to correspond with the Skill Competencies listed in the course outline.

Operations are the subdivision in the breakdown of a job. Each operation represents a process, way of doing or how to perform the particular skill competency or operation.

INFORMATION SHEETS supplement the job sheets and provide the student with information necessary for completing the assigned jobs with highest possible degree of understanding. The information units that will be stressed in the course are listed in the course outline under information lessons. The information sheets included in this section should be numbered to correspond with the Information Lessons listed in the course outline.

ASSIGNMENT SHEETS supplement the job sheets and provide the student with mental activities necessary to learn the "knowing" that accompanies the "doing" of a trade. The student is assigned related studies or technical information to be "sought out" on an individual basis through the use of problems or "exercises". The Assignment Sheets should be numbered to correspond with the Information Lessons listed.

JOB: Fasten Paper to Board

UNIT II: Drafting

COURSE: Sheet Metal

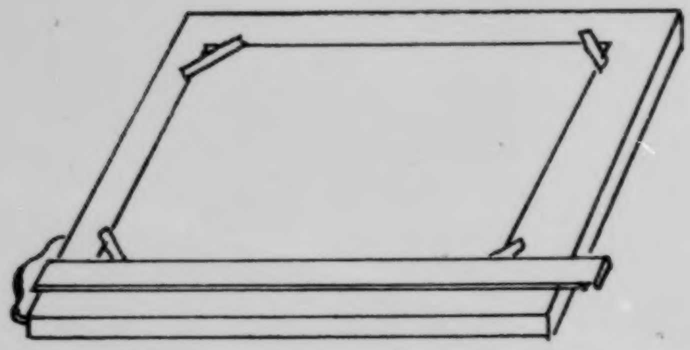
MATERIAL: Drawing Paper
Masking Tape

EQUIPMENT: Drawing Board
T-Square

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-1

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place paper on drawing board.	. SC-2-1 . SC-2-2



METHOD OF EVALUATION:

Check amount of masking tape used.
The paper should be aligned with the board.
The paper should be free of wrinkles
and lie smoothly on the board.

JOB: Draw Horizontal Lines

UNIT II: Drafting

COURSE: Sheet Metal

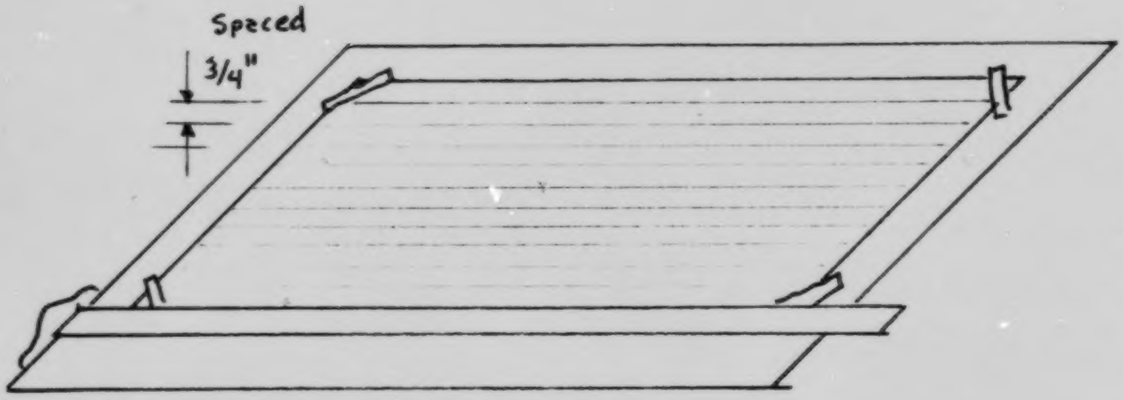
MATERIAL: Use J-2-1

EQUIPMENT: Drawing Board
T-Square

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-2

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out and draw 13 horizontal lines spaced 3/4" apart.	. SC-2-3



Keep PAPER ON BOARD FOR NEXT JOB.

METHOD OF EVALUATION:

The lines should be evenly spaced and parallel to each other and the T-square.

JOB: Draw Verticle Lines

UNIT II: Drafting

COURSE: Sheet Metal

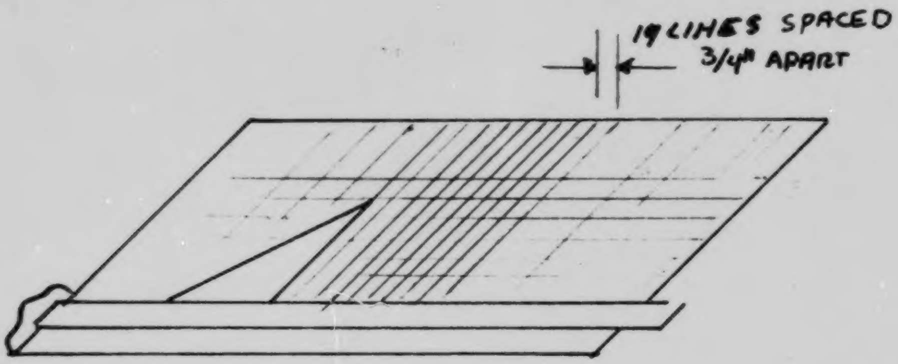
MATERIAL: Use J-2-2

EQUIPMENT: Drawing Board
T-Square
Triangles

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-3

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out and draw 19 vertical lines spaced 3/4" apart.	. SC-2-3 . SC-2-4



METHOD OF EVALUATION:

The lines should be evenly spaced and parallel to each other and the triangle.

JOB: Draw Two Squares and Two Rectangles

JOB SHEET IDENTIFICATION CODE

UNIT II: Drafting

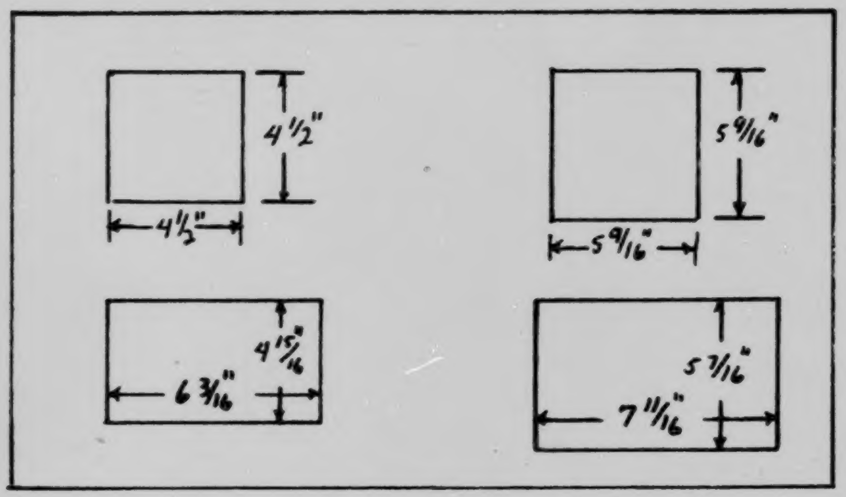
JOB NUMBER: J-2-4

COURSE: Sheet Metal

MATERIAL: Drawing Paper

EQUIPMENT: Selected by Student

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out and draw two squares one sized 4 1/2" sq. and the other 5 9/16" square.	. SC-2-1 . SC-2-2
2. Lay out and draw rectangles, one sized 4 15/16" x 6 3/16" and the other 5 7/16" x 7 11/16".	. SC-2-3 . SC-2-4 NOTE: Locate squares in general locations, and as shown, leave room for 3 and 4.

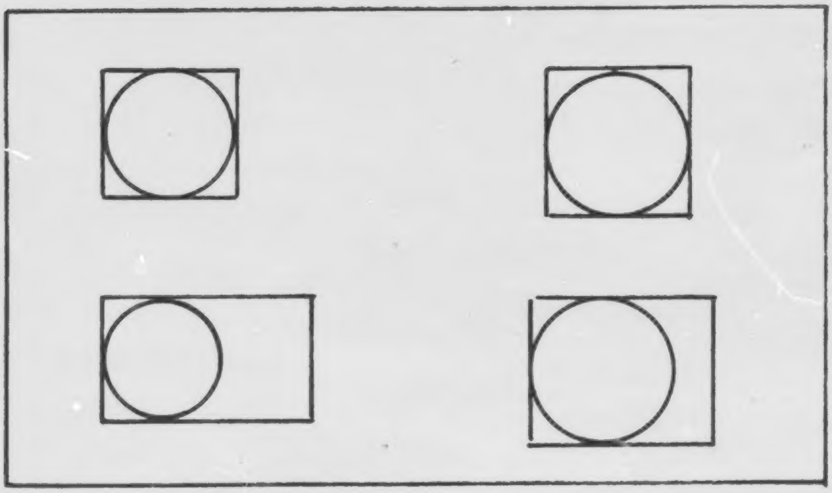


METHOD OF EVALUATION:

Check overall dimensions and placement of each square on the paper. Check for proper drawing tool techniques.

JOB:	Draw Four Circles	**JOB SHEET IDENTIFICATION CODE**	
UNIT II:	Drafting	JOB NUMBER:	J-2-5
COURSE:	Sheet Metal		
MATERIAL:	Use J-2-4		
EQUIPMENT:	Selected by Student		

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Draw circles in each of the four drawings in J-2-4. Position circle to touch four sides of the squares and two sides of rectangle, however, do not extend circle outside rectangles.	. SC-2-5



METHOD OF EVALUATION:

Check dimensions and placement of circles in squares and rectangles.
Check for proper drawing tool technique.

JOB: – Draw Hexagon

UNIT II: Drafting

COURSE: Sheet Metal

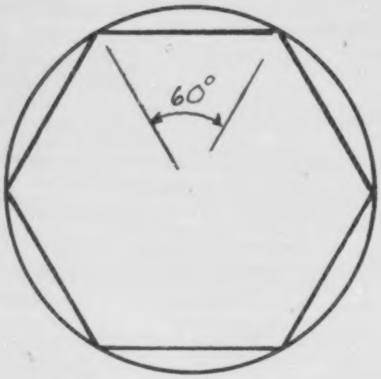
MATERIAL: Drawing Paper

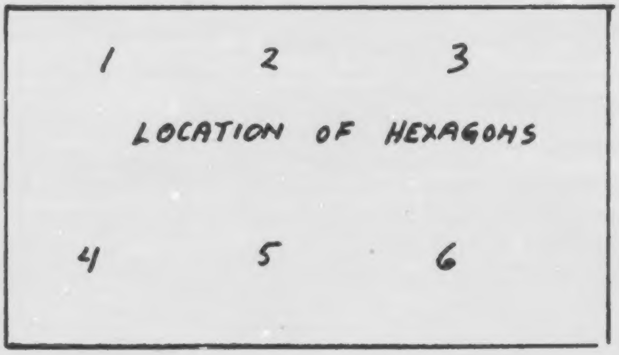
EQUIPMENT: Selected by Student

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-6

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out and draw six hexagons as shown.	. SC-2-1 . SC-2-2 . SC-2-4 . SC-2-5 . SC-2-6





METHOD OF EVALUATION:

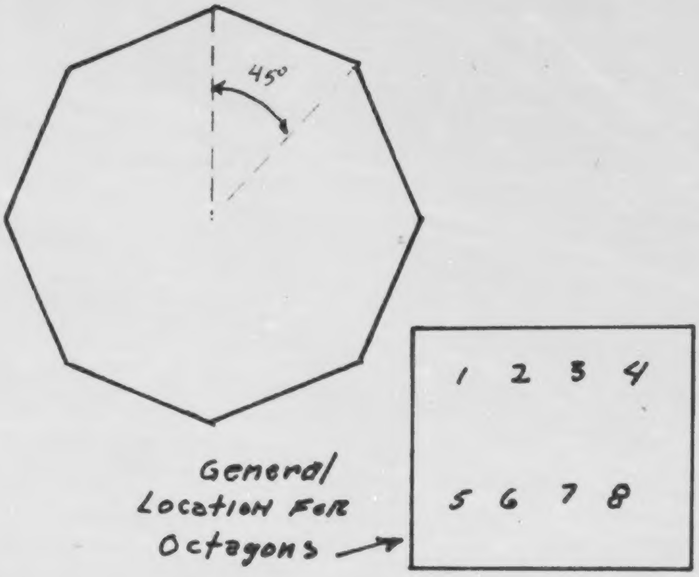
Check dimensions and proper construction techniques of hexagon.

JOB:	Draw Octagon
UNIT II:	Drafting
COURSE:	Sheet Metal
MATERIAL:	Drawing Paper
EQUIPMENT:	Selected by Student

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-2-7

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Draw eight octagons, two in each of four scales. a. Full scale = 5 13/16" b. Half scale c. Quarter scale d. Eight scale	. SC-2-5 . SC-2-6 . SC-2-7



METHOD OF EVALUATION:

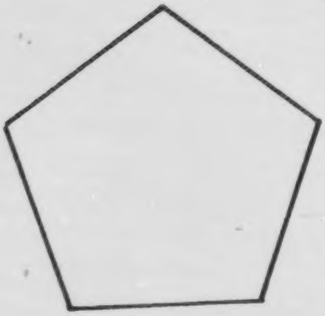
Check scale of each octagon for proper size.
Check for proper construction techniques for octagon.

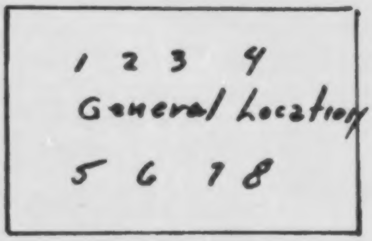
JOB: Draw Pentagon
UNIT II: Drafting
COURSE: Sheet Metal
MATERIAL: Drawing Paper
EQUIPMENT: Selected by Student

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-8

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Draw eight pentagons, two in each of four scales. a. Full scale = 6 3/16" b. Half scale c. Quarter scale d. Eight scale	. SC-2-6 . SC-2-7





METHOD OF EVALUATION:

Check scale size.
Check for proper construction techniques for pentagon.

JOB: Draw an Ellipse

UNIT II: Drafting

COURSE: Sheet Metal

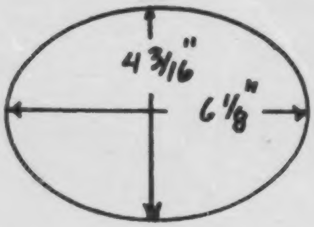
MATERIAL: Drawing Paper

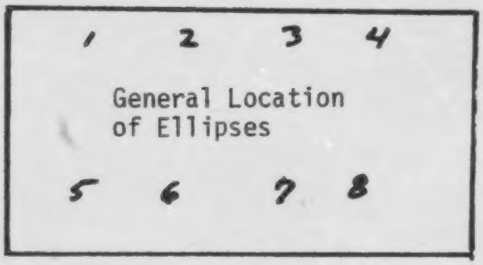
EQUIPMENT: Selected by Student

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-9

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out and draw eight ellipses. Two in each of four scales. a. Full scale = 6 1/8" major 4 3/16 minor b. Half scale c. Quarter scale d. Eight scale	. SC-2-7





METHOD OF EVALUATION:

Check scale size.
Check for proper construction techniques for ellipse.

JOB: Draw Angles

UNIT II: Drafting

COURSE: Sheet Metal

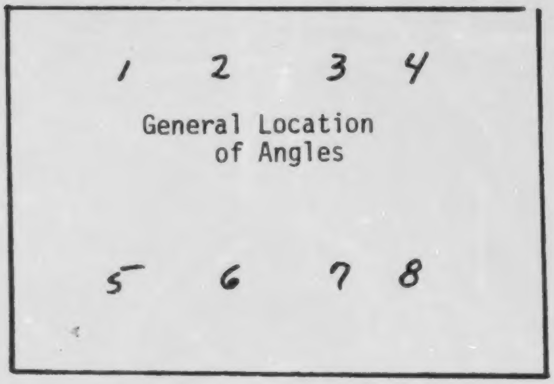
MATERIAL: Drawing Paper

EQUIPMENT: Selected by Student

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-10

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out and draw eight angles, all full scale; 27°, 37°, 47°, 52°, 78°, 99°, 109°, 139°.	. SC-2-8



METHOD OF EVALUATION:

Check angles for proper degrees.
Check for proper angle construction techniques.

JOB: Obtain Material

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: Mixture of 28, 22 and 18 Gage Black and Galvanized Metal

TOOLS: Metal Gage
Micrometer

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-1

SAFETY PRECAUTIONS:

The edge of metal is sharp, be careful not to cut your hand.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Obtain three pcs. of metal, each of a different gage.	. SC-3-1, SC-3-2
2. Record on this sheet the thicknesses in gage and thousandths of an inch.	

	Gage	Thousandths
28		
22		
18		

METHOD OF EVALUATION:

Check metal to see if gages match answers provided by student.

JOB: Measure and Mark Plate

JOB SHEET
IDENTIFICATION CODE

UNIT III: Hand Tools and Machines

JOB NUMBER: J-3-2

COURSE: Sheet Metal

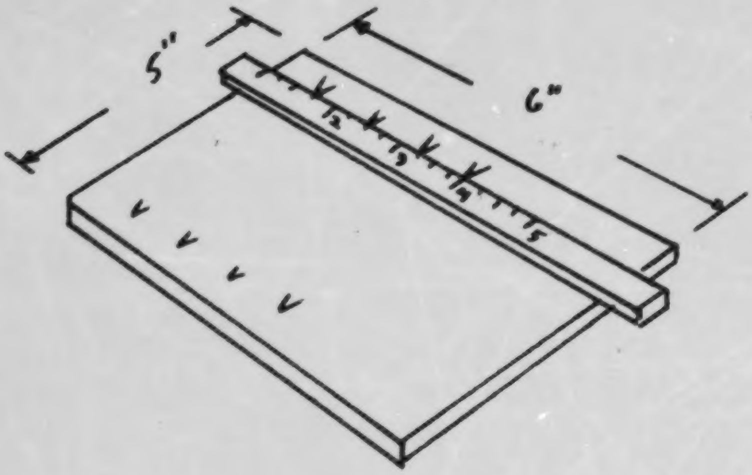
MATERIAL: 28 Gage Galvanized 5" X 6" Metal

TOOLS: Metal Gage
Micrometer
Rule
Scriber

SAFETY PRECAUTIONS:

Care should be taken so the metal does not slip through your hands; the edge is sharp and can cut you.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Gage metal.	. SC-3-1
2. Check thickness in thousandths with micrometer.	. SC-3-2
3. Measure and mark metal into eight 3/4" spaces as shown.	. SC-3-3



METHOD OF EVALUATION:

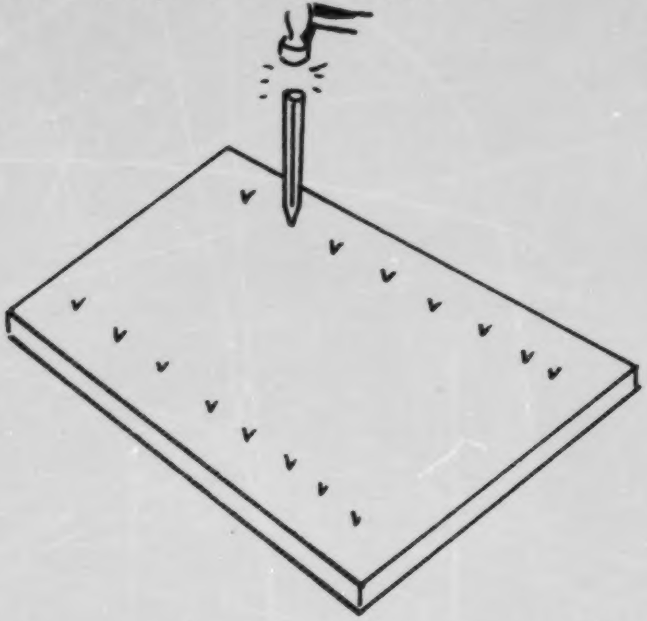
Check accuracy of layout.
Check for proper marking technique and "V" construction.

JOB:	Prick Mark a Plate	JOB SHEET IDENTIFICATION CODE
UNIT III:	Hand Tools and Machines	JOB NUMBER: J-3-3
COURSE:	Sheet Metal	
MATERIAL:	J-3-2	
TOOLS:	Hammer Prick Punch	

SAFETY PRECAUTIONS:

When using hammer, be sure to hit the intended object, not your hand.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Use J-3-2 and prick mark as shown.	. SC-3-4



METHOD OF EVALUATION:

Check depth and placement of prick marks.

JOB: Lay Out Parallel Lines

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized 5" X 6" Metal

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-4

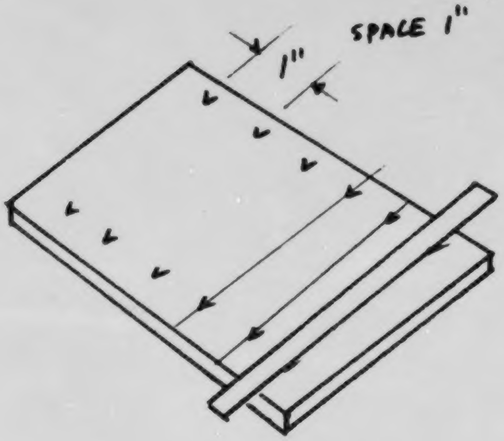
TOOLS:

- Metal Gage
- Micrometer
- 12" or Longer Scale Rule
- Scriber
- Hammer
- Punch

SAFETY PRECAUTIONS:

If your scriber should slip when you are scribing, it could cut you.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Gage metal.	. SC-3-1 through SC-3-5
2. Check with micrometer.	
3. Measure and mark six 1" spaces as shown.	
4. Scribe lines between marks.	



METHOD OF EVALUATION:

Check for proper scribing techniques.
Check straightness and visability of scribed lines.
The scribed line should pass directly through the center of the tip on the vee of the scribed marks.

JOB: Cut Parallel Lines

JOB SHEET IDENTIFICATION CODE

UNIT III: Hand Tools and Machines

JOB NUMBER: J-3-5

COURSE: Sheet Metal

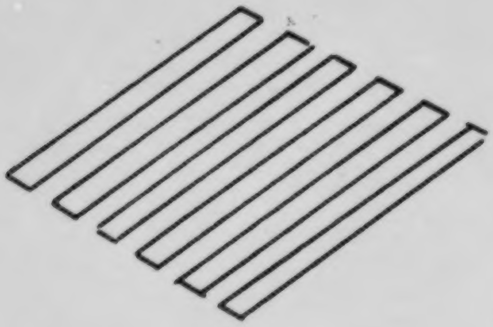
MATERIAL: J-3-4

TOOLS: Hand shears

SAFETY PRECAUTIONS:

Hand shears can cut or pinch you, think before you cut.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Cut the metal strips.	. SC-3-6



METHOD OF EVALUATION:

The strips should be cut straight and be free of fishhooks or rough edges.

JOB: Remove Sharp Edge

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: J-3-5

TOOLS: File

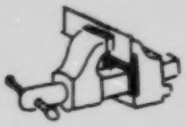
JOB SHEET
IDENTIFICATION CODE

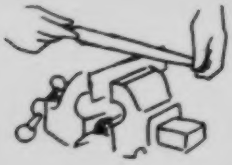
JOB NUMBER: J-3-6

SAFETY PRECAUTIONS:

When using a file be careful not to slip. A slip could file your skin off.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. File the metal to remove the sharp edges.	. SC-3-7





METHOD OF EVALUATION:

The metal should have smooth edges with no sharp places.
Proper filing technique.

JOB: Fabricate a Square Plate

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Metal 6" X 6" (should not be square)

JOB SHEET IDENTIFICATION CODE

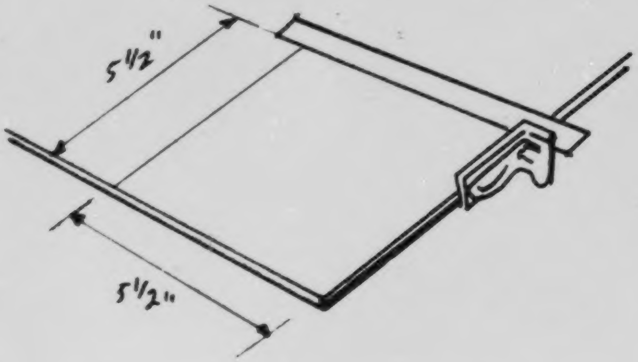
JOB NUMBER: J-3-7

TOOLS:
- Rule
- Scriber
- File
- Hammer
- Punch
- Metal Gage
- Scale
- Hand Shear
- Combination Square

SAFETY PRECAUTIONS:

Practice good work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Measure and mark the metal.	. SC-3-3 through SC-3-8
2. Square the metal.	NOTE: SC-3-1 and SC-3-2 will not be listed from now on because practice has been assured. SC-3-1 and SC-3-2 will continue to be used on future jobs.
3. Prick punch the metal.	
4. Scribe lines between the marks.	
5. Cut the metal.	
6. File the metal.	



METHOD OF EVALUATION:

Check plate for squareness.
Proper use of square to square metal.

JOB: Fabricate Rectangular Plate

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Metal 4" X 8"

EQUIPMENT: Squaring Shear

JOB SHEET IDENTIFICATION CODE

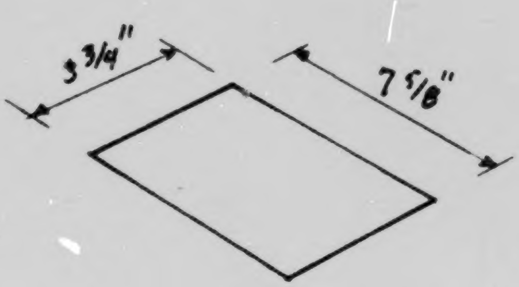
JOB NUMBER: J-3-8

TOOLS:
- Scale
- Hand Shear
- Gage
- File
- Combination Square
- Scribe
- Prick Punch
- Hammer

SAFETY PRECAUTIONS:

Squaring shears cannot tell what they cut. If your finger is in the blade's path, it will be cut.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Rough cut the metal.	. SC-3-5 through SC-3-9
2. Measure and mark it.	NOTE: SC-3-3 and SC-3-4 will not be listed from now on because practice has been assured.
3. Square the metal.	
4. Scribe the lines.	
5. Shear the metal.	



METHOD OF EVALUATION:

Check corners of plate for squareness.

JOB: Fabricate a Single Hem

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized 3" X 6" Metal

EQUIPMENT: Cornice Brake
Squaring Shear

TOOLS: Scriber, Metal Gage, Hammer, Scale, Square, Prick Punch

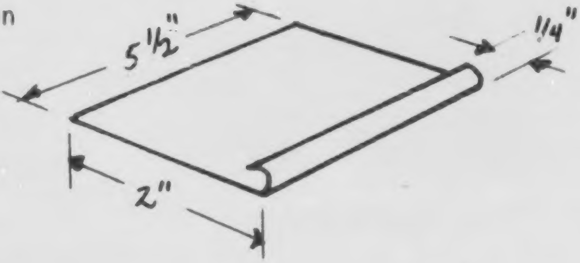
JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-9

SAFETY PRECAUTIONS:

Cornice brakes will grip and bend metal or your body, be careful when using it.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Rough cut the material.	. SC-3-8 through SC-3-10
2. Measure and mark it.	NOTE: Although SC-3-5, SC-3-6 and SC-3-7 will be used on future jobs, they will not be listed from now on because practice has been assured.
3. Square the bend line.	
4. Scribe the lines.	
5. Cut the material.	
6. Use cornice brake to bend on bend marks.	



METHOD OF EVALUATION:

Check for proper cornice brake procedures.
Check for tightness and uniform width of formed hem.

JOB: Groove Seam a Plate

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized 5" X 6" Metal

EQUIPMENT: Cornice Brake
Squaring Shear

JOB SHEET
IDENTIFICATION CODE

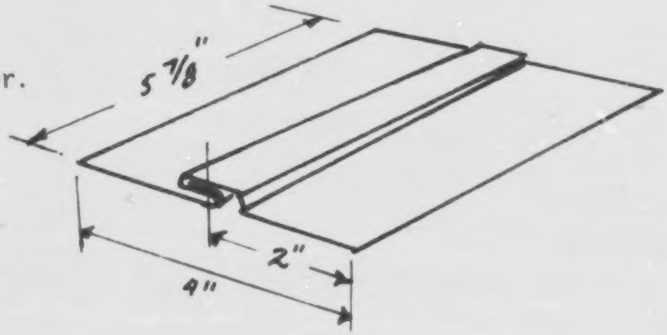
JOB NUMBER: J-3-10

TOOLS:
Metal Gage
Rule
Hammer
Prick Punch
Scale
Square
Groove Seamer
Scriber

SAFETY PRECAUTIONS:

When striking metal with metal, wear goggles.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Rough cut the metal.	. SC-3-9 through SC-3-11
2. Measure and mark it.	
3. Square the bend lines.	
4. Cut the material.	
5. Bend on bend marks.	
6. Seam together with groove seamer.	



METHOD OF EVALUATION:

Check for proper groove seaming techniques.
Check formed seam for tightness of fit.
There should be no groove seamer marks on top of the seam itself.
The seam should be flush underneath.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-11

JOB: Fabricate a Square Tube

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Metal

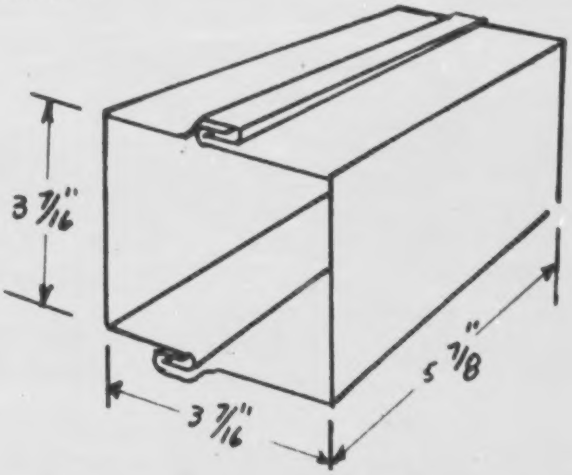
EQUIPMENT:
Squaring Shear
Cornice Brake
Bar Folder

TOOLS:
Groove Seamer
Basic Hand Tools

SAFETY PRECAUTIONS:

Bar folders will bend and squeeze. Be sure you bend or squeeze only the intended material.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select the metal.	. SC-3-10 through SC-3-12
2. Cut it to size.	
3. Bend for grooved seam in bar folder.	
4. Bend the four corners 90°.	
5. Groove the seam together.	



METHOD OF EVALUATION:

Check overall appearance and accuracy of job.
Check tube for squareness, all bends should have equal value at the corners.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-12

JOB: Fabricate a Hexagonal Plate

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

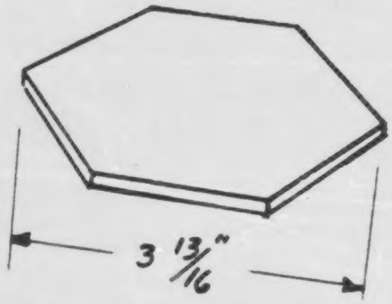
MATERIAL: 26 Gage Galvanized Metal

TOOLS: Dividers
Basic Hand Tools

SAFETY PRECAUTIONS:

Dividers should be sharp so that they can scratch metal. Be careful that they don't scratch you.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select the material.	. SC-3-13
2. Lay it out to size.	
3. Cut it to size.	



METHOD OF EVALUATION:

Check for accuracy of layout.
Check for proper gage selection.

JOB: Fabricate a Hexagonal Tube

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-13

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Metal
Solder
Flux

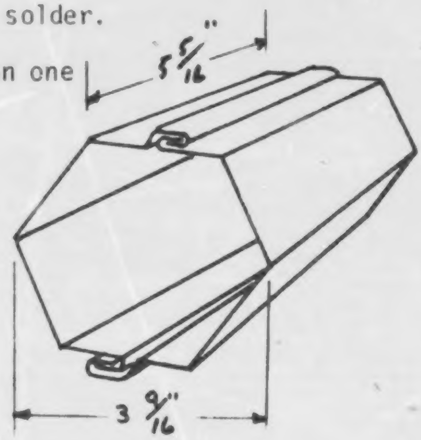
EQUIPMENT: Squaring Shear
Cornice Brake
Bar Folder

TOOLS: Soldering Iron
Basic Hand Tools

SAFETY PRECAUTIONS:

50/50 solder melts at 365°, this is 153° hotter than boiling water. This could burn you.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-11, SC-3-12
2. Cut and bend it to size.	. SC-3-14
3. Assemble the grooved seam and solder.	
4. Solder hex plate from J-3-12 on one end of the tube.	



METHOD OF EVALUATION:

Check for overall appearance and accuracy.
Check bends for proper amount of bend (each bend should have equal amount of bend).
Check for soundness and appearance of soldered joints.
Check to be sure all soldered joints were properly cleaned after soldering.

JOB: Fabricate an Octagonal Plate

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Metal

TOOLS: Hand Punch
Basic Hand Tools

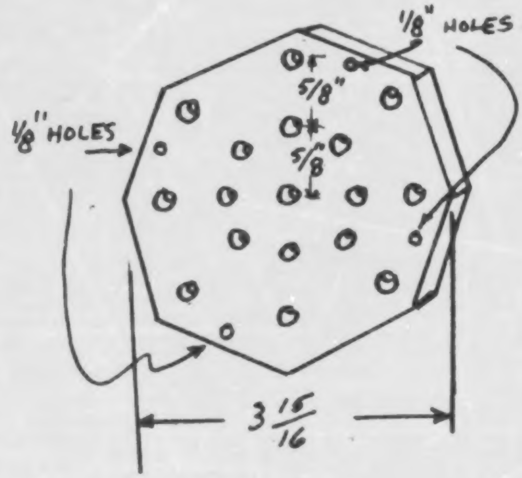
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-14

SAFETY PRECAUTIONS:

A hand punch will make a hole in sheet steel or anything of less strength. It can easily punch through your hand or arm.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-13
2. Cut it to size.	. SC-3-15
3. Punch 3/16" holes on 5/8" C_L spacing.	



4. Punch 1/8" holes 1/4" from edge and centered on sides as shown.

METHOD OF EVALUATION:

Check hole spacing.
Check for proper punching procedure.
Check overall size and appearance of job.

JOB: Fabricate a Pentagonal Plate

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 18 Gage Galvanized Metal
Solder
Rivets

EQUIPMENT: Selected by the Student

TOOLS: Rivet Set
Hand Punch

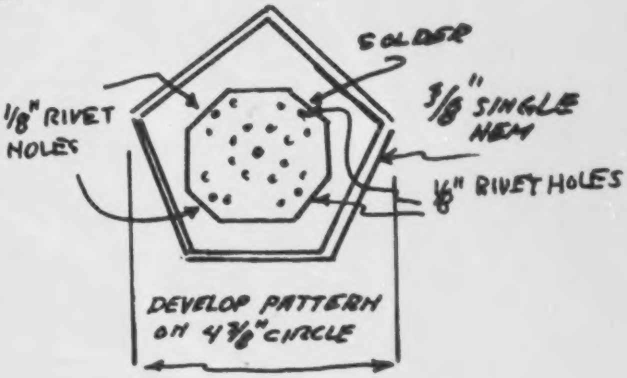
JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-15

SAFETY PRECAUTIONS:

When striking metal against metal, wear goggles.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the pentagonal.	. SC-3-12 through SC-3-16
2. Cut it to size.	
3. Punch 1/8" holes in pentagonal plate to match holes in octagonal plate from J-3-14.	
4. Single hem the pentagon.	
5. Rivet and solder J-3-14 to this plate as shown.	


SOLDER
3/8" SINGLE HEM
1/8" RIVET HOLES
1/8" RIVET HOLES
DEVELOP PATTERN ON 4 3/8" CIRCLE

METHOD OF EVALUATION:

Check overall accuracy and appearance of plate.

JOB: Fabricate a Hanger

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 20 Gage Galvanized Metal
Rivets

EQUIPMENT: Selected by the Student

TOOLS: Hand Punch
Rivet Set
Clamps

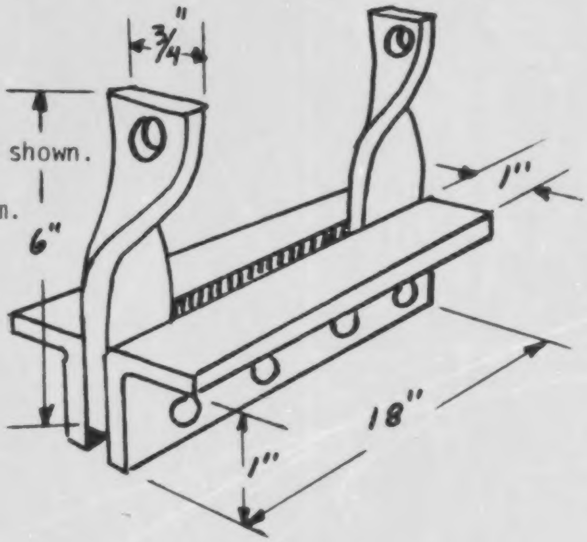
SAFETY PRECAUTIONS:

Practice good work habits.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-16

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-15 through SC-3-17
2. Cut it to size.	
3. Bend 1" X 1" angle 90°.	
4. Twist 3/4 X 20 gage metal as shown.	
5. Clamp together and rivet them.	



METHOD OF EVALUATION:

Check overall accuracy and appearance of hanger.
Check rivets for proper tightness and set.
Check twist of hanger for uniformity.

JOB: Fabricate a Rectangular Plate

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Metal

EQUIPMENT: Coper Notcher

TOOLS: Selected by the Student

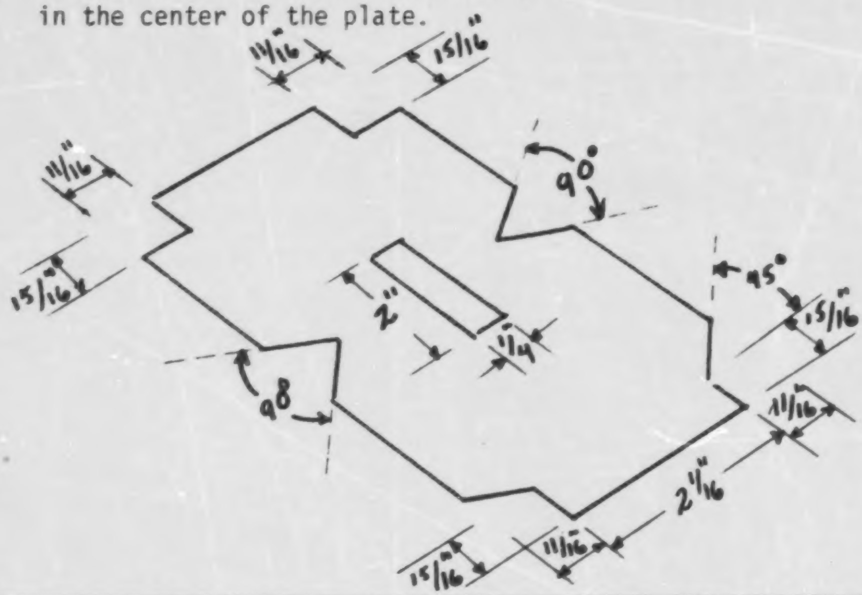
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-17

SAFETY PRECAUTIONS:

Be careful not to cut yourself.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	
3. Notch it to size.	. SC-3-18
4. Punch a series of holes and file a slot in the center of the plate.	



METHOD OF EVALUATION:

Check for proper notcher procedures.
Check to be sure notches are not cut beyond proper length.
Check plate for overall accuracy and appearance.

JOB:	Fabricate a Pipe Hanger
UNIT III:	Hand Tools and Machines
COURSE:	Sheet Metal
MATERIAL:	1/8" X 1" Flat Bar
TOOLS:	Hacksaw Electric Drill Other Appropriate Tools

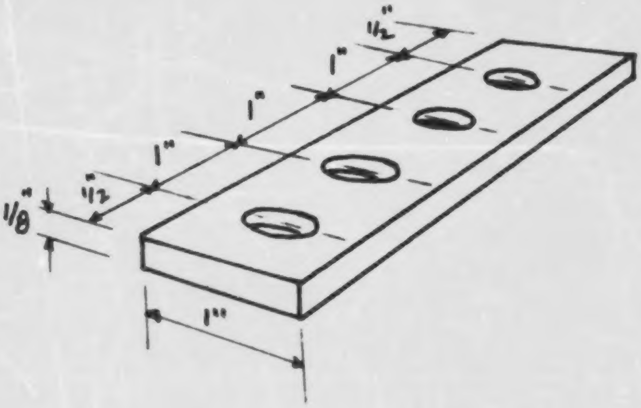
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-18

SAFETY PRECAUTIONS:

You are cutting steel. Small pieces of steel can harm your eyes. Protect yourself.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut the material to size.	. SC-3-19, SC-3-20
3. Clamp and drill holes.	



METHOD OF EVALUATION:

Check for proper use of hacksaw.
Check drilling procedure.
Check for overall accuracy and appearance of hanger.

JOB: Fabricate Two Square Pans

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Metal

EQUIPMENT: Box and Pan Brake
Other Appropriate Equipment

TOOLS: Basic Hand Tools

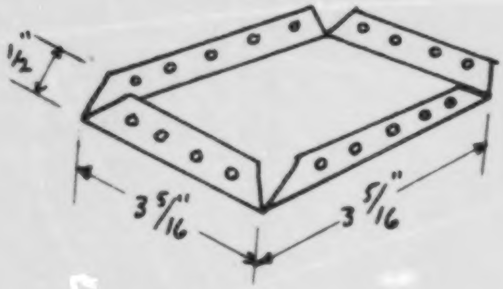
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-19

SAFETY PRECAUTIONS:

Remember brakes can grip, bend and squeeze. Think about what you are doing.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	. SC-3-18
3. Punch 1/8" holes (allow for proper edge clearance and spacing).	. SC-3-21
4. Bend it to size.	



METHOD OF EVALUATION:

Check for proper box and pan brake procedures.
Check overall accuracy and appearance of pans.

JOB: Fabricate a Square Container

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Metal Rivets

EQUIPMENT: Turret Punch
Other Appropriate Equipment

TOOLS: Basic Hand Tools

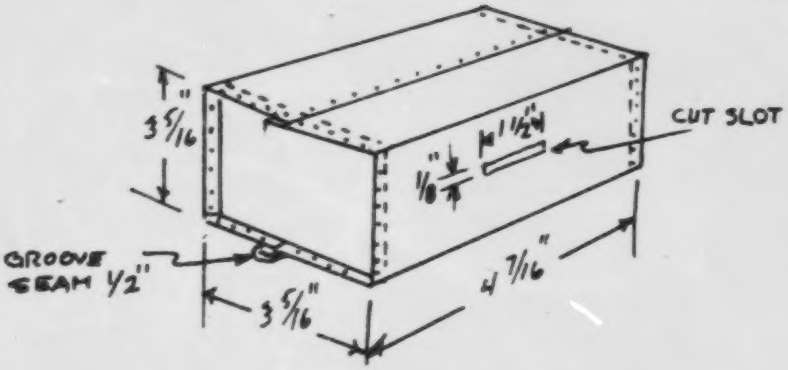
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-20

SAFETY PRECAUTIONS:

When out of control the turret punch handle can bruise your body.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	
3. Punch 1/8" holes (same spacing as J-3-17).	. SC-3-14
4. Bend to size.	
5. Rivet one side of the square tube and groove seam the other side as shown.	. SC-3-16
6. Rivet the ends to the tube. (Use J-3-17).	. SC-3-17, SC-3-19, SC-3-20 . SC-3-22



METHOD OF EVALUATION:

Check container for overall accuracy and appearance.
Check riveted seam alignment and tightness of joint.

JOB: Fabricate a Pentagonal Container

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Metal
Rivets

EQUIPMENT: Spot Welder
Other Appropriate Equipment

TOOLS: Basic Hand Tools

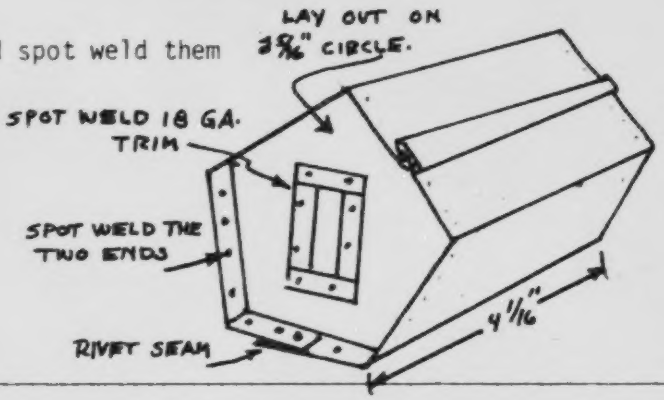
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-21

SAFETY PRECAUTIONS:

The sparks that fly from a spot welder are red. This means they are hot--over 1000^0.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	NOTE: Lay out pentagon on 3 5/16 circle.
2. Cut it to size.	. SC-3-17
3. Bend it to proper shape.	. SC-3-19 through SC-3-23
4. Groove the seam and rivet the pentagonal tube together.	
5. Insert the two ends and spot weld them to the tube	
6. Solder the two ends.	



METHOD OF EVALUATION:

Check overall appearance and accuracy of container.
Check for proper spot welding techniques and procedure.
Check spot welds for soundness and appearance.

JOB: Fabricate Round Pipe

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Metal

EQUIPMENT: Slip Rolls
Other Appropriate Equipment

TOOLS: Basic Hand Tools

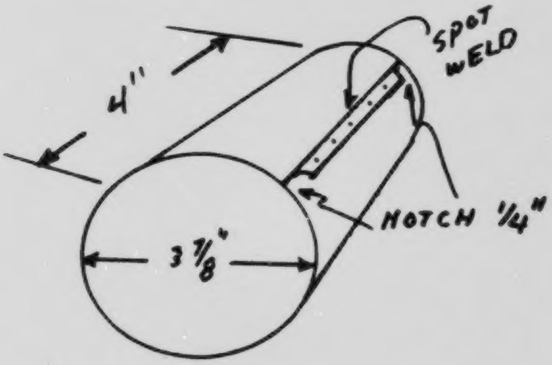
JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-22

SAFETY PRECAUTIONS:

Slip rolls grip and bend metal or other things that may be placed in them. Think about your hands.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-23
2. Cut it to size.	. SC-3-24
3. Roll it to the proper shape.	
4. Spot weld it together.	



METHOD OF EVALUATION:

Check for proper slip roll procedures and techniques.
Check for roundness of pipe there should be no flat spots at seam.
Check overall accuracy and appearance of pipe.

JOB: Burr Two Ends for J-3-22

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: J-3-22

EQUIPMENT: Burring Machine

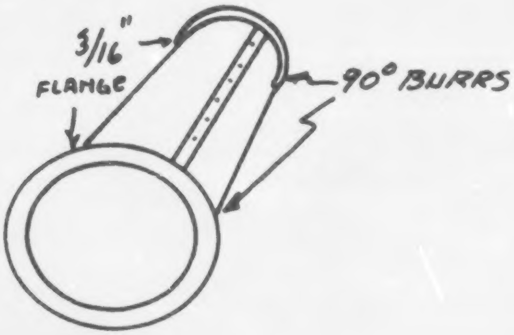
JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-23

SAFETY PRECAUTIONS:

Burring machines shape metal or other things, be careful when you use it.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Use J-3-22 and burr the two ends 3/16".	. SC-3-25



METHOD OF EVALUATION:

Check for proper burring technique and procedure.
Burred edge should be relatively free of buckles or wrinkles.
Burred edge should be 90° to pipe surface and uniform in size.

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-24

JOB: Fabricate Two End Caps for J-3-23

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Metal

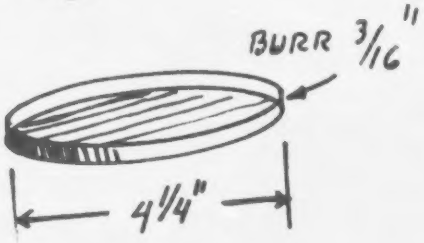
EQUIPMENT: Ring and Circle Machine

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

The ring and circle machine cuts metal. Like other metal cutting machines, it cannot tell what it is cutting, be careful.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-25
2. Cut it to size on ring and circle machine.	. SC-3-26
3. Burr 3/16" edge.	



METHOD OF EVALUATION:

Check overall accuracy and appearance of end caps.
Check for proper ring and circle shear techniques and procedures.
Check for smoothness and uniformity of burred edge.

JOB: Assemble J-3-22 and J-3-23

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: J-3-22
J-3-23

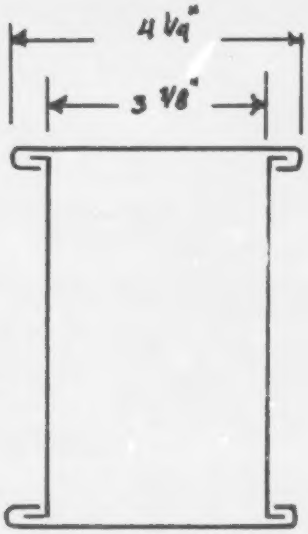
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-25

SAFETY PRECAUTIONS:

It hurts when you pinch your finger; think about that.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Use J-3-22 and J-3-23 and assemble them using the single hem method.	. SC-3-27



METHOD OF EVALUATION:

Check overall accuracy and appearance of assemblies.
Check for proper setting down procedures and techniques.
Check seams for uniformity and tightness.

JOB: Form a Double Seam on J-3-25

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: J-3-25

EQUIPMENT: Double Seam Machine

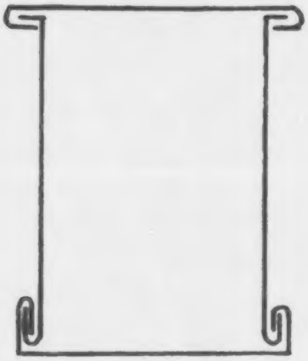
SAFETY PRECAUTIONS:

Work safely.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-26

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING LEARNING ACTIVITIES
1. Double seam one end of J-3-25.	. SC-3-28



METHOD OF EVALUATION:

Check for proper doubleseaming techniques and procedure.

JOB: Make a Round Cup

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Wire Rivets

EQUIPMENT: Wire Edge Rolls
Other Appropriate Equipment

TOOLS: Inside Calipens
Other Basic Hand Tools

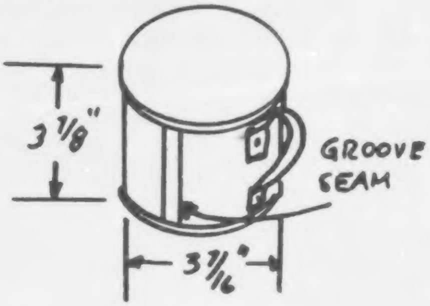
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-27

SAFETY PRECAUTIONS:

Metal edges are sharp; wear gloves to help prevent cuts.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-22
2. Cut it to size.	. SC-3-24
3. Use the bar folder to form the pocket for the wire.	. SC-3-25
4. Wire edge.	. SC-3-26
5. Roll it to shape.	. SC-3-27
6. Double seam the bottom.	. SC-3-28
7. Rivet the handle.	. SC-3-29
	. SC-3-30



METHOD OF EVALUATION:

Check overall accuracy and appearance of cup.
Check proper wire edge forming techniques and procedures.
Wire edge should be tight and metal should cover wire uniformly.
Wire seam should be opposite grooved seam.

JOB: Make a Round Bank

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Metal

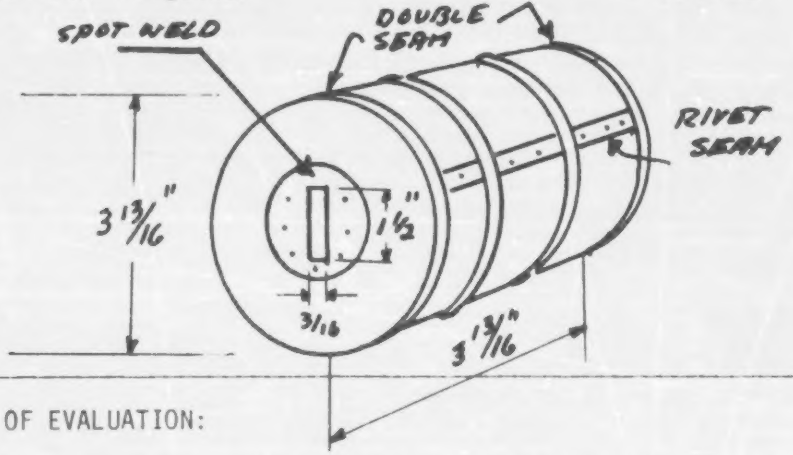
EQUIPMENT: Beading Machine
Other Appropriate Equipment

TOOLS: Outside Calipens
Other Basic Hand Tools

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-28

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-23
2. Cut it to size.	. SC-3-24
3. Roll it to shape.	. SC-3-26
4. Rivet the round tube together.	. SC-3-27
5. Bead the round tube.	. SC-3-28
6. Cut a slot in one end and spot weld reinforcement rims.	. SC-3-31
7. Double seam together.	. SC-3-32



METHOD OF EVALUATION:

Check for proper beading techniques and procedure.
Check bead for appearance and depth.
Check overall appearance and accuracy of bank.

JOB: Make a Round Dipper

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Metal
1/8" x 1" Flat Bar

EQUIPMENT: Band Saw
Other Appropriate Equipment

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Band saws throw off tiny pieces of steel, be careful of your eyes.

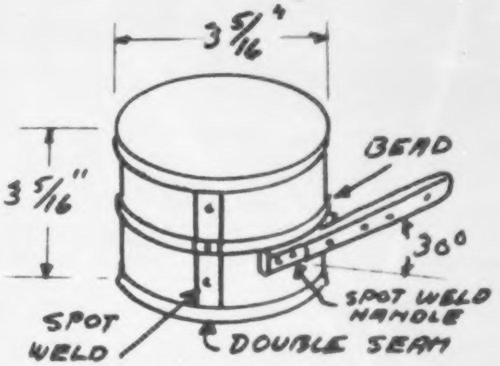
JOB SHEET
IDENTIFICATION CODE

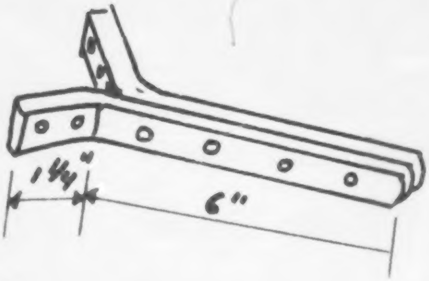
JOB NUMBER: J-3-29

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Select and lay out the material.
2. Cut it to size.
3. Form pocket for wire on the piece that will be the round tube.
4. Roll the round tube to shape and spot weld it.
5. Punch 1/8" holes in the bottom and double seam it to the tube.
6. Fabricate the handle out of two pieces 1/8" x 1" flat bar.
7. Spot weld the flat bars together.





METHOD OF EVALUATION:

Check for proper band sawing techniques and procedure.
Check overall accuracy and appearance of dipper.

JOB: Make a Cone

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Metal

EQUIPMENT: Forming Stakes
Other Appropriate Equipment

TOOLS: Basic Hand Tools

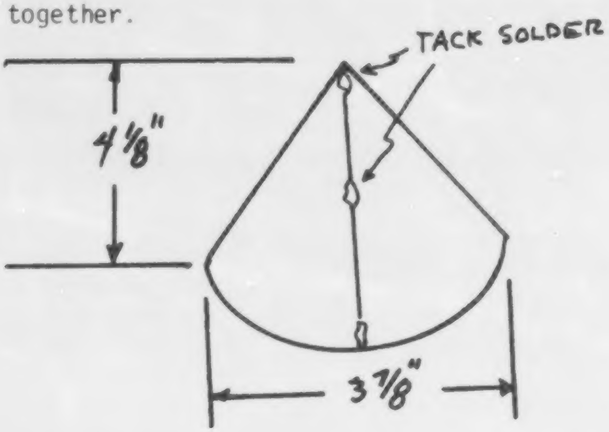
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-30

SAFETY PRECAUTIONS:

If your hand slips across the edge of the metal, you will get a painful cut.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-32 . SC-3-34
2. Cut it to size.	
3. Shape it on forming stakes.	
4. Tack solder the cone together.	



METHOD OF EVALUATION:

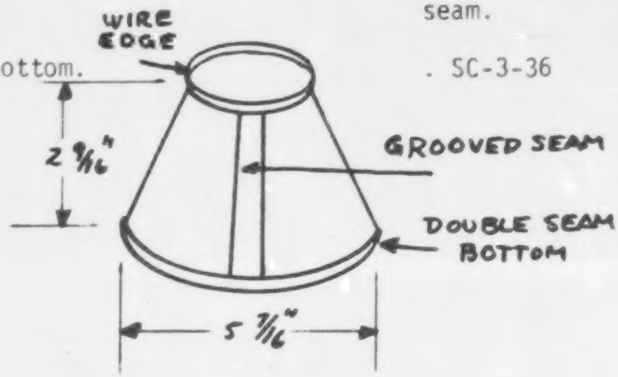
Check for proper hand forming techniques.
Check for proper stake selection.
Check roundness of cone opening there should be no flat spots.
Check overall accuracy and appearance of cone.

JOB:	Fabricate a Frustum of a Cone	JOB SHEET IDENTIFICATION CODE
UNIT III:	Hand Tools and Machines	JOB NUMBER: J-3-31
COURSE:	Sheet Metal	
MATERIAL:	28 Gage Galvanized Metal Wire	
EQUIPMENT:	Slip Rolls Other Appropriate Equipment Turning Machine	
TOOLS:	Basic Hand Tools	

SAFETY PRECAUTIONS:

Think safety, work safely, be safe.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-29
2. Cut it to size.	. SC-3-30
3. Shape it on slip rolls.	. SC-3-31
4. Groove the seam together.	. SC-3-35
5. Wire edge the top.	NOTE: Notch back grooved seam.
6. Double seam the bottom.	. SC-3-36



METHOD OF EVALUATION:

Check for overall accuracy and appearance.
Check for proper assembly procedures.

JOB: Make a Funnel

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Metal

EQUIPMENT: Unishear
Other Appropriate Equipment

TOOLS: Basic Hand Tools

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-32

DRAWING NO.: D-3-32

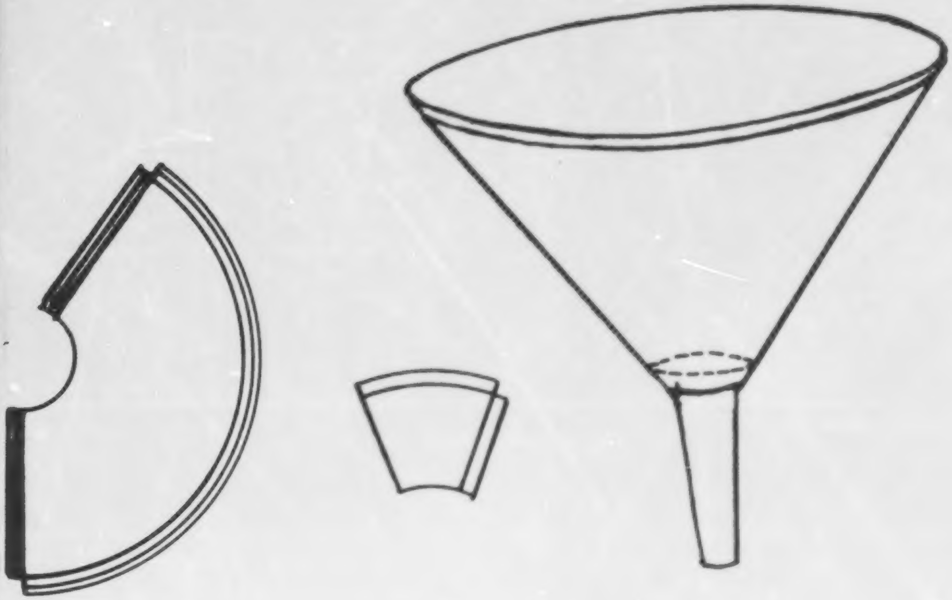
SAFETY PRECAUTIONS:

The unishear will cut things other than metal. Be careful not to cut yourself.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-34
2. Cut it to size.	. SC-3-35
3. Shape it on the slip rolls and forming stake.	. SC-3-36
4. Groove the seam and wire edge the top part.	. SC-3-37
5. Solder it together and flange the bottom part.	
6. Solder the bottom to the top.	

METHOD OF EVALUATION:

Check for proper shearing techniques and procedure.
Check funnel for overall accuracy and appearance.



FUNNEL

DRAWING NUMBER
D-3-32

JOB: Make Measuring Cup

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 3/16" x 1 1/4" Flat Bar
26 Gage Galvanized Metal
Rivets

EQUIPMENT: Drill Press
Other Appropriate Equipment

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET
IDENTIFICATION CODE

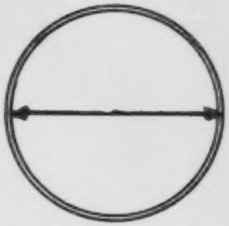
JOB NUMBER: J-3-33

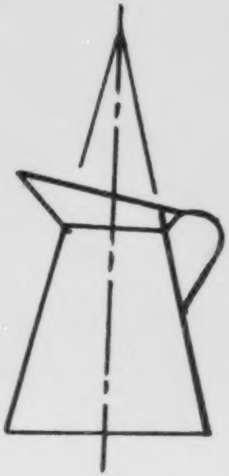
DRAWING NO.: D-3-33

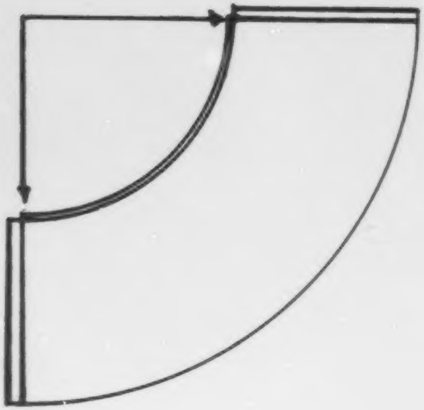
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-33
2. Cut it to size.	. SC-3-34
3. Roll the body to shape.	. SC-3-35
4. Form the top over forming stakes.	. SC-3-36
5. Burr lip on the top of the body.	. SC-3-37
6. Place the top over the body and solder it in place.	. SC-3-38
7. Lay out the handle as shown, the wide part goes to the top of the body.	
8. Rivet the handle to the body.	
9. Double seam the bottom to the body.	

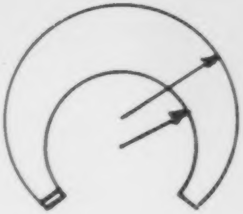
METHOD OF EVALUATION:

Check for proper drilling procedure and technique.
Check cup for overall accuracy and appearance.









MEASURING CUP

81

DRAWING NUMBER

D-3-33

JOB: Make a Tool Box

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 24 Gage Galvanized Metal
3/16" x 1 1/4" Flat Bar
Hinge and Hasp
Bolts
Rivets

EQUIPMENT: Selected by the Student

TOOLS: Screwdriver
Wrench
Other Basic Hand Tools

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-3-34

DRAWING NO.: D-3-34

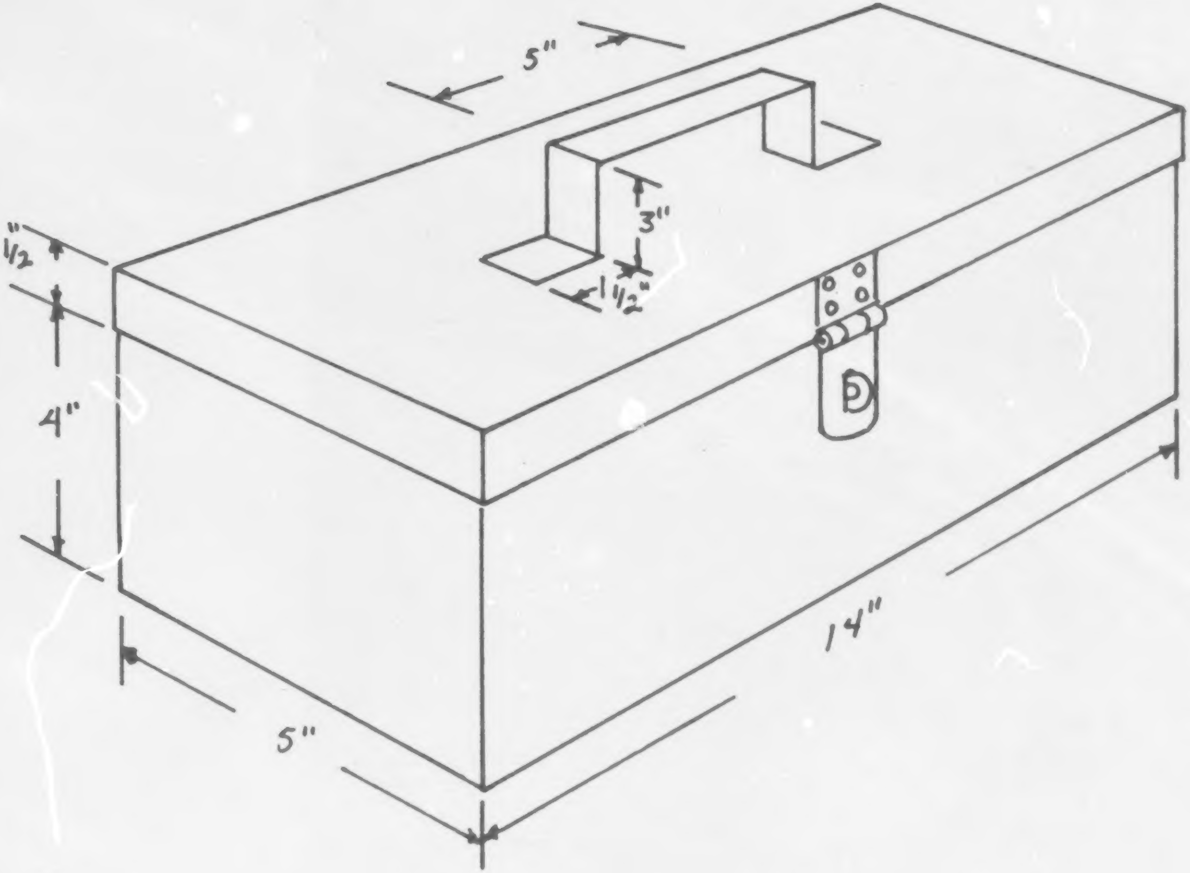
SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-21
2. Cut it to size.	
3. Bend it to shape.	. SC-3-33
4. Bolt the handle and lock hasp.	. SC-3-37
5. Rivet on the hinge.	. SC-3-38

METHOD OF EVALUATION:

Check overall accuracy and appearance of tool box.
Check for proper assembly procedure.
Check for proper hinge and hasp alignment and for the lid fit.


5"
3"
1½"
1½"
4"
14"
5"

TOOL BOX

83

DRAWING NUMBER
D-3-34

JOB: Make a Discharge Stack and Hood

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Metal
1/8" x 1" Flat Bar

EQUIPMENT: Selected by the Student

TOOLS: Taps and Other Appropriate Hand Tools

JOB SHEET
IDENTIFICATION CODE

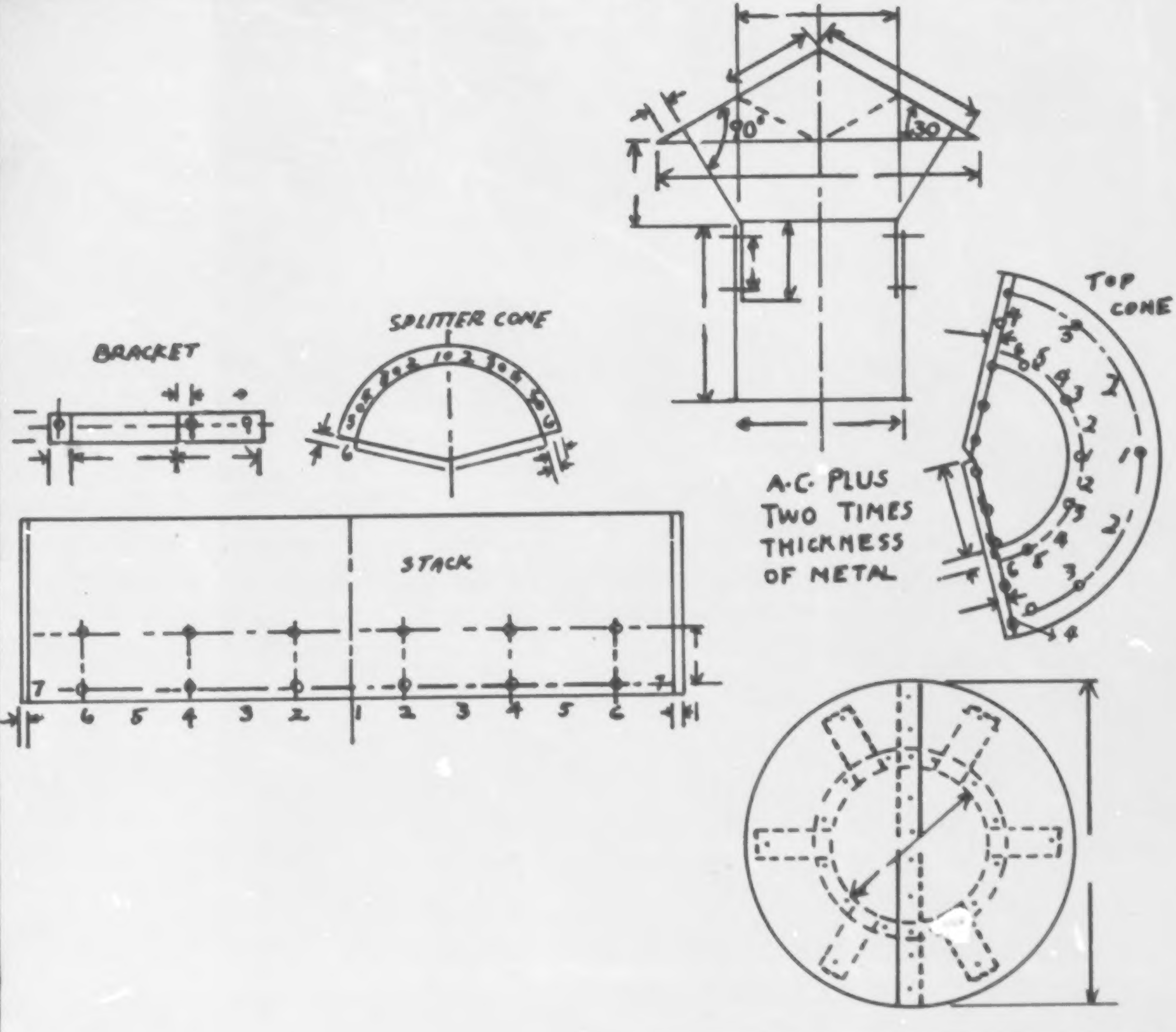
JOB NUMBER: J-3-35

DRAWING NO.: D-3-35

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-38
2. Lay out the top cone.	
3. Lay out half pattern for hood.	. SC-3-39
4. Lay out the stack pattern.	
5. Lay out the splitten cone.	. SC-3-40
6. Lay out the bracket patterns.	. SC-3-41
7. Drill and tap the brackets.	
8. Shape all patterns and assemble them.	

METHOD OF EVALUATION:

Check stack hood for overall accuracy and appearance.
Check for proper assembly procedure.


BRACKET
SPLITTER CONE
STACK
TOP CONE
90°
30
A.C. PLUS TWO TIMES THICKNESS OF METAL
7 6 5 4 3 2 1 2 3 4 5 6 7
1 2 3 4 5 6

DISCHARGE STACK AND HOOD

DRAWING NUM

D-3-35

JOB: Fabricate a Two Piece 45° Elbow
UNIT III: Hand Tools and Machines
COURSE: Sheet Metal
MATERIAL: 28 Gage Galvanized Metal
EQUIPMENT: Elbow Lock Rolls
TOOLS: Basic Hand Tools

JOB SHEET IDENTIFICATION CODE
JOB NUMBER: J-3-36
DRAWING NO.: D-3-36

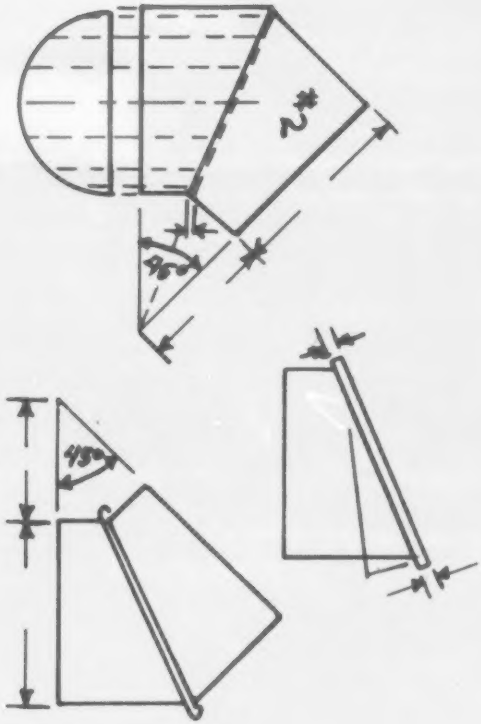
SAFETY PRECAUTIONS:

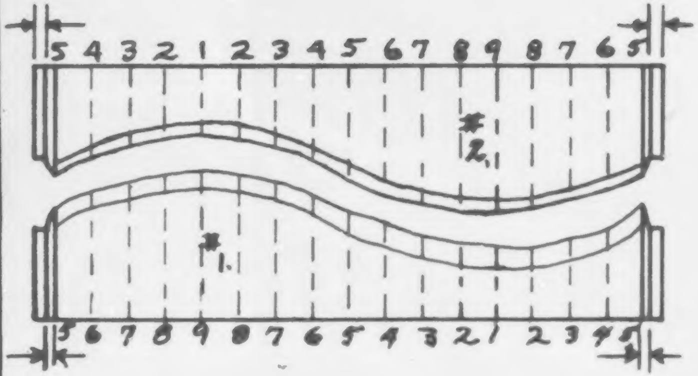
Practice good work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-42
2. Cut it to size.	
3. Bend it for grooved seam.	
4. Roll it to shape.	
5. Form the elbow lock.	
6. Assemble as shown.	

METHOD OF EVALUATION:

Check overall accuracy and appearance of elbow.
Check for proper elbow edging techniques and procedure.
Check finished elbow angle.




5 4 3 2 1 2 3 4 5 6 7 8 9 8 7 6 5
#2
#1
5 6 7 8 9 8 7 6 5 4 3 2 1 2 3 4 5

FABRICATE A TWO PIECE 45° ELBOW

DRAWING NU

D-3-36

JOB: Make a Round Offset

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Metal

EQUIPMENT: Crimping Machine

TOOLS: Basic Hand Tools

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-37

DRAWING NO.: D-3-37

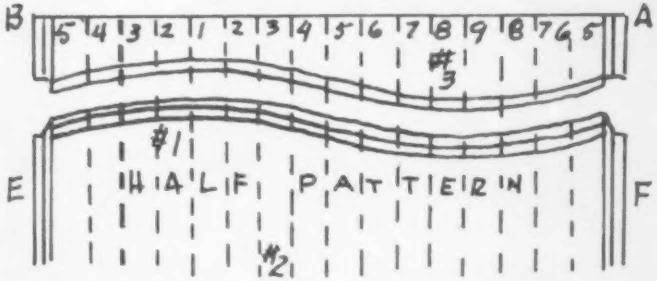
SAFETY PRECAUTIONS:

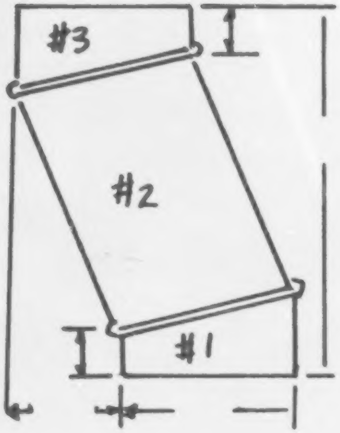
Observe all safety rules while operating the crimping machine.

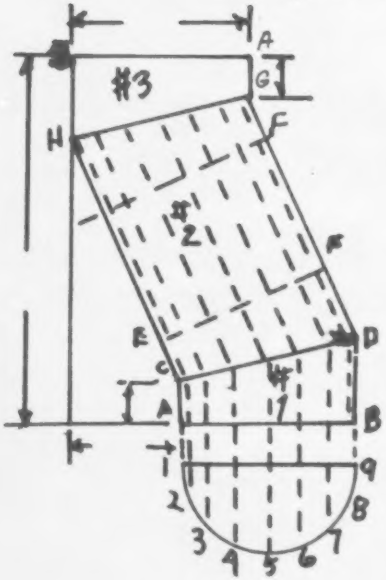
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-42
2. Cut it to size.	
3. Bend it for the grooved seam.	. SC-3-43
4. Roll it to shape.	
5. Form the lock.	
6. Assemble as shown.	
7. Crimp one end.	

METHOD OF EVALUATION:

Check for proper crimping technique and procedure.
Check depth of crimp for uniformity and size.
Check overall accuracy and appearance of offset.


B
A
5 4 3 2 1 2 3 4 5 6 7 8 9 8 7 6 5
#3
#1
HALF PATTERN
E
F
#2




A
#3
G
H
F
#2
F
E
C
D
#1
A
B
1
9
2
8
3
4
5
6
7

MAKE A ROUND OFFSET

DRAWING NUMBER

D-3-37

JOB: Make a Three Piece Elbow

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Metal

EQUIPMENT: Selected by the Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice good work habits.

JOB SHEET IDENTIFICATION CODE

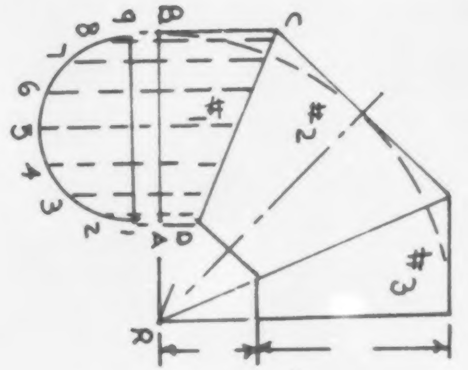
JOB NUMBER: J-3-38

DRAWING NO.: J-3-38

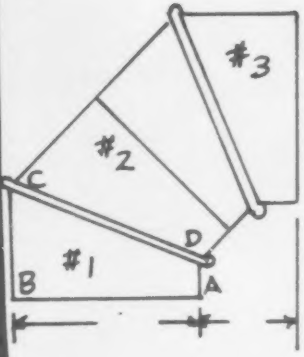
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	. SC-3-42
3. Shape the metal.	
4. Form the lock.	. SC-3-43
5. Assemble as shown.	
6. Crimp one end.	

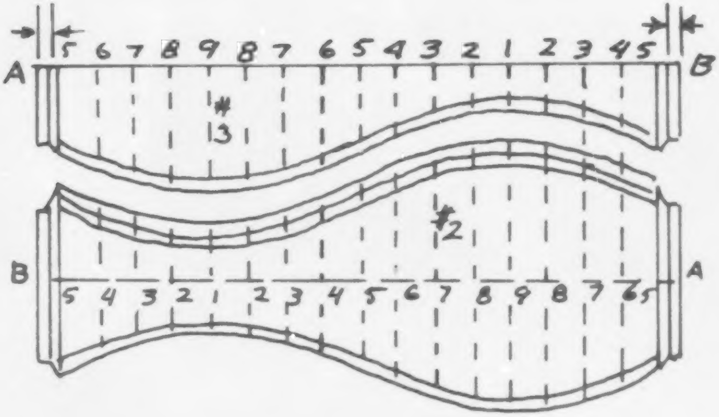
METHOD OF EVALUATION:

Check overall accuracy and appearance of elbow.



B
C
9
8
7
6
5
4
3
2
A
D
#1
#2
#3
R





A
5 6 7 8 9 8 7 6 5 4 3 2 1 2 3 4 5
B
#3
#2
B
5 4 3 2 1 2 3 4 5 6 7 8 9 8 7 6 5
A

MAKE A THREE PIECE ELBOW

DRAWING NUMBER

D-3-38

JOB: Fabricate a Taper Square to Round "T"

UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

MATERIAL: 26 Gage Metal
1/4" x 3/4" Flat Bar

EQUIPMENT: Selected by the Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice good work habits.

JOB SHEET IDENTIFICATION CODE

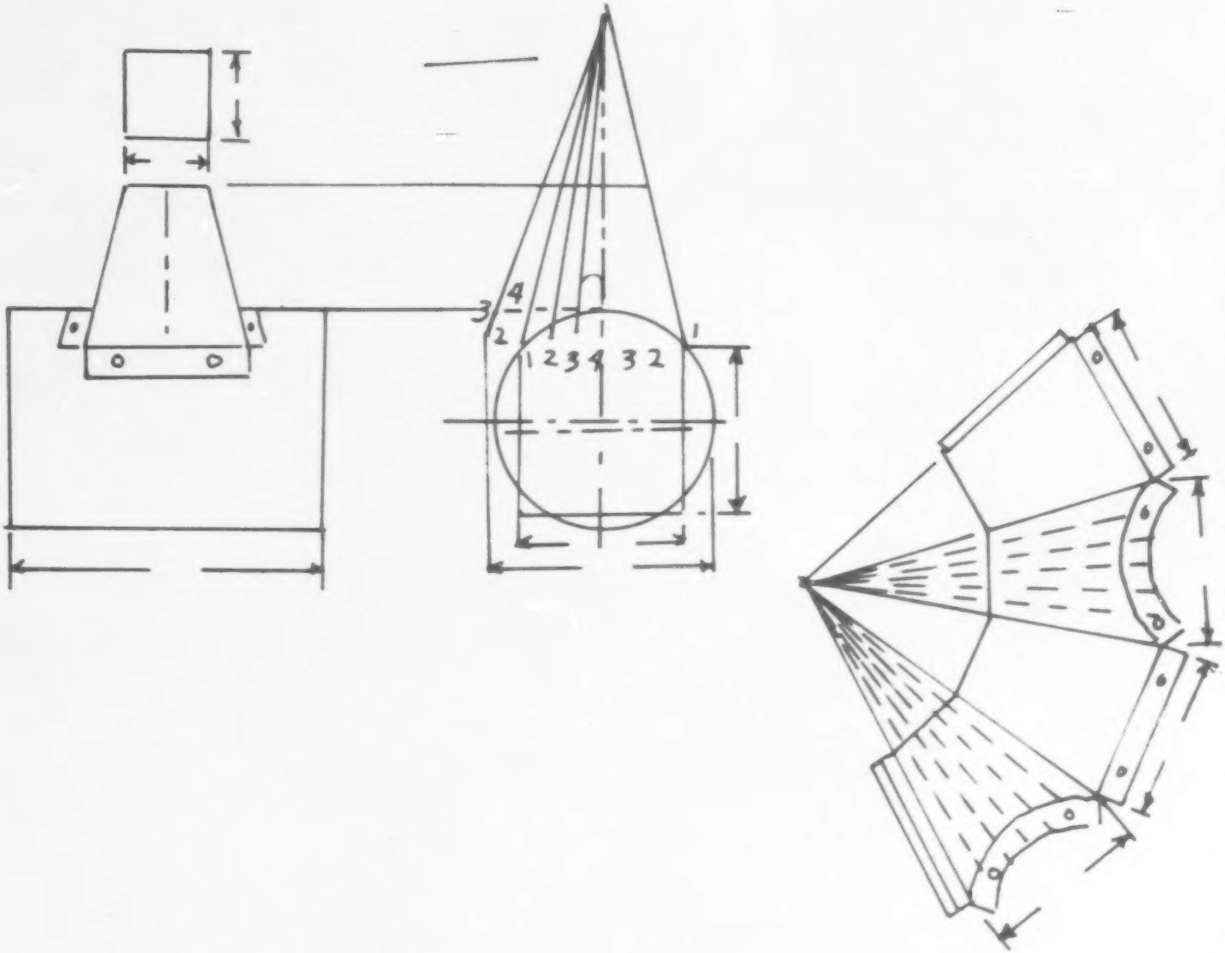
JOB NUMBER: J-3-39

DRAWING NO.: D-3-39

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-3-41
2. Cut it to size.	. SC-3-43
3. Shape the metal.	. SC-3-44
4. Offset the large end of the tapering square to fit the round pipe.	
5. Assemble as shown.	
6. Crimp one end.	

METHOD OF EVALUATION:

Check overall appearance and accuracy of job.
Check tightness and fit of lap seam.


4
3
2
1
1 2 3 4 3 2
1

FABRICATE A TAPER SQUARE TO ROUND "T"

DRAWING NUMBER

D-3-39

JOB: Make a Metal Chute

JOB SHEET
IDENTIFICATION CODE

UNIT III: Hand Tools and Machines

JOB NUMBER: J-3-40

COURSE: Sheet Metal

MATERIAL: 18 Gage Black Iron
1/8" X 1" Flat Bar

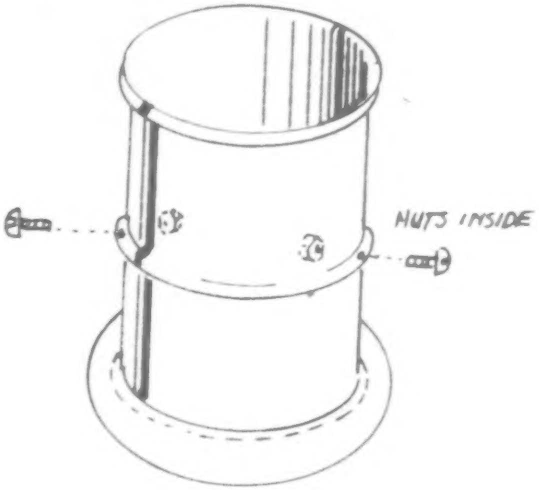
EQUIPMENT: Combination Rotary Machine
  A. Slip Roll
  B. Offsetting Roll

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice good work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHINE/LEARNING ACTIVITIES
1. Select and lay out material.	. SC-3-41
2. Cut it to size.	
3. Punch and drill holes.	. SC-3-44
4. Roll to shape.	
5. Offset and burr.	
6. Assemble as shown.	



METHOD OF EVALUATION:

Check for proper offsetting techniques and procedure.
Check overall accuracy and appearance of chute.

JOB: Transport Oxy-Acetylene Cylinders

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: Acetylene Cylinder
Oxygen Cylinder

EQUIPMENT: Oxy-Acetylene Cart

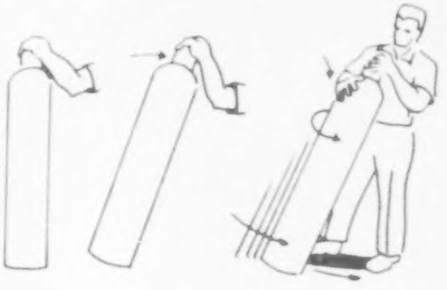
JOB SHEET
IDENTIFICATION CODE

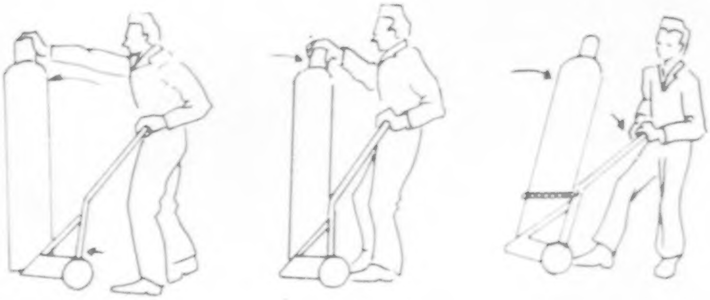
JOB NUMBER: J-4-1

SAFETY PRECAUTIONS:

No cylinder will be moved at any time without the protective caps in place.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Unchain acetylene cylinder from wall, place on cart and chain in place.	. SC-4-1
2. Repeat step #1 using oxygen cylinder.	
3. Transport to welding area.	
4. Check with instructor.	





METHOD OF EVALUATION:

Check that all safety procedures are followed.
Check for angle of tank and placement of hands on the tank.

JOB: Set up Gas Weld Equipment

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: Oxygen Cylinder
Acetylene Cylinder
Brush and Soapy Water

EQUIPMENT: Oxy-Acetylene Outfit
Oxy-Acetylene Cart

TOOLS: Tank Wrench

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-2

SAFETY PRECAUTIONS:

Cylinders must be chained in place.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Transport cylinders to welding truck.	. SC-4-1
2. Set up gas welding equipment.	. SC-4-2

METHOD OF EVALUATION:

Check all connections for fit and leaks.
Check that tanks were blown off properly.

JOB: Close Oxygen Acetylene Equipment

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: Oxygen Cylinder
Acetylene Cylinder

EQUIPMENT: Oxy-Acetylene Outfit
Oxy-Acetylene Cart

TOOLS: Tank Wrench

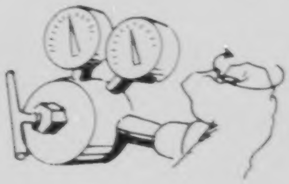
SAFETY PRECAUTIONS:

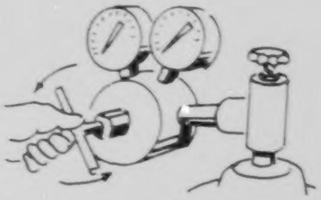
Practice safe work habits.

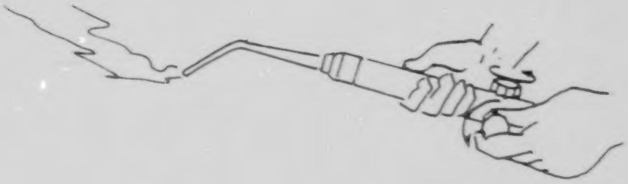
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-3

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Close oxy-acetylene equipment.	. SC-4-3







METHOD OF EVALUATION:

Check proper closing procedures.
Check all gages for "o" reading.
Check regulator valve tightness.

JOB: Clean and Select Tip

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: Oxygen and Acetylene

EQUIPMENT: Oxy-Acetylene Outfit

TOOLS: Tank Wrench
Tip Cleaner

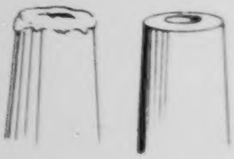
JOB SHEET
IDENTIFICATION CODE

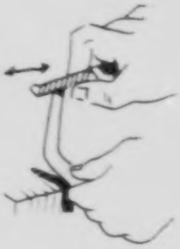
JOB NUMBER: J-4-4

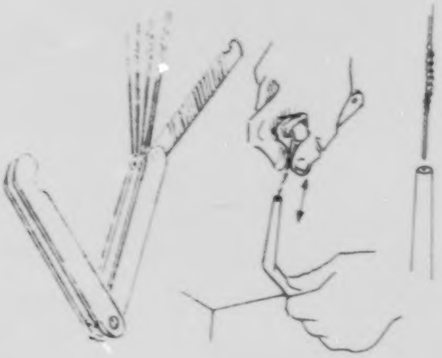
SAFETY PRECAUTIONS:

Do not ram, twist or turn the cleaner, cleaner should float freely.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. File tip edges and face.	
2. Clean tip opening.	. SC-4-4
3. Use chart to select proper tip size.	







METHOD OF EVALUATION:

Check proper tip cleaning procedure and technique.

JOB: Light and Adjust Torch

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: Oxygen and Acetylene

EQUIPMENT: Selected by the Student

TOOLS: Striker
Other Appropriate Tools

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-5

SAFETY PRECAUTIONS:

There is going to be a flame at the end of the tip, be careful where it is pointed.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and clean proper tip.	
2. Open oxy-acetylene equipment.	
3. Light and adjust the torch to neutral flame.	. SC-4-4
4. Light and adjust torch to oxidizing flame.	. SC-4-5
5. Light and adjust torch to carburizing flame.	. SC-4-6

METHOD OF EVALUATION:

Check for proper lighting procedures.
Check for proper oxidizing flame adjustment.
Check for neutral flame adjustment.
Check for carburizing flame adjustment.

JOB: Cut a Plate

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: 5" x 8" x 16 Gage Black Iron

EQUIPMENT: Bench Lever Shear

TOOLS: Basic Hand Tools

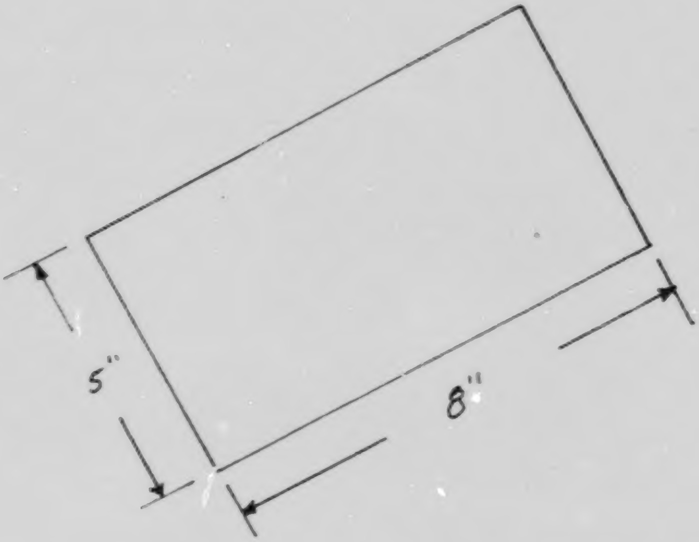
JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-6

SAFETY PRECAUTIONS:

Observe caution when using shears, they are sharp.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	. SC-4-8
2. Cut it to size using bench lever shear.	NOTE: Save plate for welding practice.



METHOD OF EVALUATION:

Check for proper bench shear techniques and procedure.
Check plate for smoothness of cut.

JOB: Weld Name on Plate

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: 5" x 8" Plate (J-4-6)
1/16" Filler Rod

EQUIPMENT: Selected by the Student

TOOLS: Basic Hand Tools

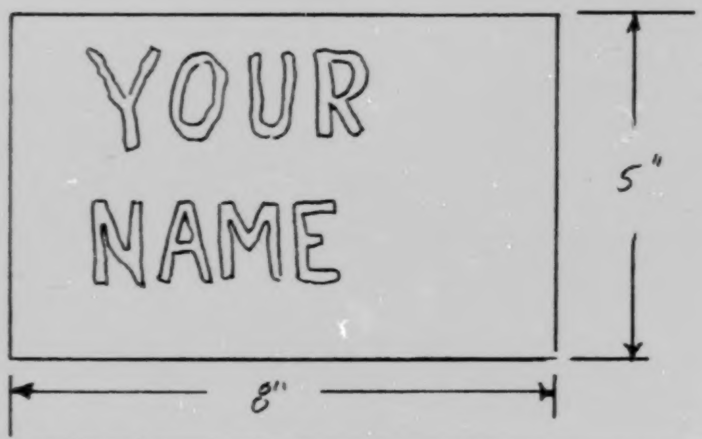
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-7

SAFETY PRECAUTIONS:

Metal can be very hot and not be red. Protect your hands by wearing welding gloves.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Weld first name on plate without filler rod.	. SC-4-3
2. Weld last name on plate with 1/16" filler rod.	. SC-4-4 . SC-4-5 . SC-4-8



METHOD OF EVALUATION:

Check proper welding techniques and procedure.
Check name for uniformity of bead height and width.
Check contour of bead and uniformity of ripples.

JOB: Edge Weld

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: (2) pieces 2" x 6" x 16 Gage Metal

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

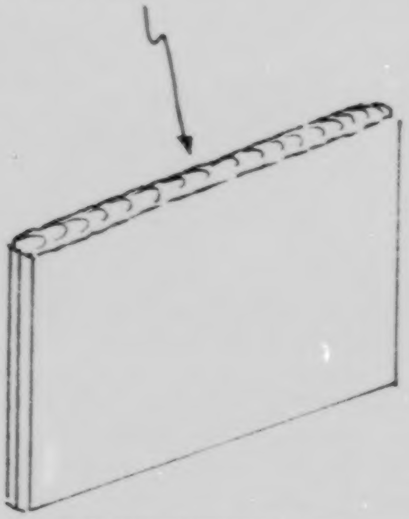
SAFETY PRECAUTIONS:

Think safe, work safe, be safe.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-8

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	. SC-4-5
2. Cut to size.	
3. Clamp two plates together.	. SC-4-6
4. Tack weld plates in place.	. SC-4-7
5. Weld one side only as shown.	. SC-4-8



METHOD OF EVALUATION:

The metal should have smooth edges with no sharp places.
Proper filing technique.

JOB: Weld a Corner Joint

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: (4) Pieces 2 1/2" x 8" x 16 Gage Black Iron
Oxygen and Acetylene

EQUIPMENT: Goggles
Gloves
Clamps
Oxy-Acetylene Equipment
Welding Tips

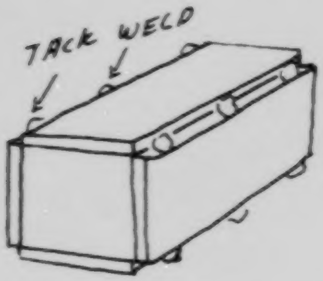
JOB SHEET IDENTIFICATION CODE

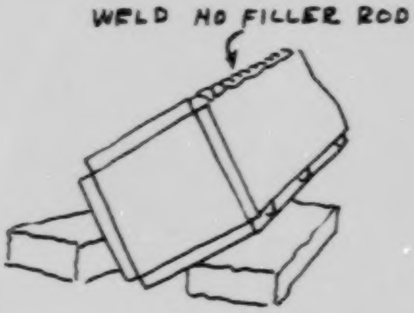
JOB NUMBER: J-4-9

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-4-6
2. Cut to size.	
3. Align and tack weld as shown.	. SC-4-7
4. Weld the four corner joints without a filler rod.	. SC-4-8





METHOD OF EVALUATION:

Check weld joint for penetration and appearance.
Check for proper welding techniques and procedure.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-10

JOB: Weld a Corner Joint

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: (4) Pieces 2 3/4" x 10" x 16 Gage Black Iron
Filler Rod
Oxygen
Acetylene

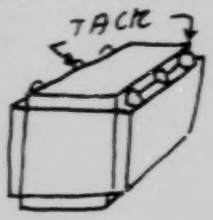
EQUIPMENT:

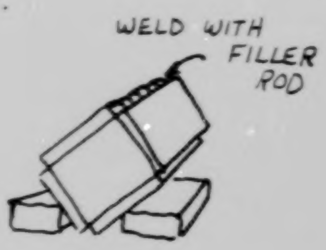
Oxy-Acetylene Equipment	Goggles
Hand Grinder	Gloves
Welding Tips	Clamps

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-4-8
2. Cut it to size.	. SC-4-9
3. Align and tack weld as shown.	
4. Weld the four corner joints with filler rod.	
5. Grind two corner joints.	





METHOD OF EVALUATION:

Check for proper grinding procedure and techniques.
Check weld soundness.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-11

JOB: Weld a Butt Joint

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: (8) Pieces 2" x 8" x 16 Gage Black Iron
Filler Rod

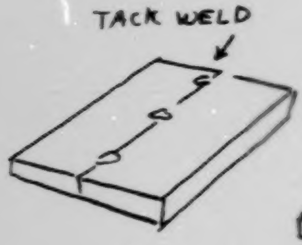
EQUIPMENT: Selected by Student

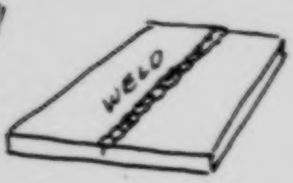
TOOLS: Basic Hand Tools

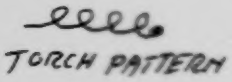
SAFETY PRECAUTIONS:

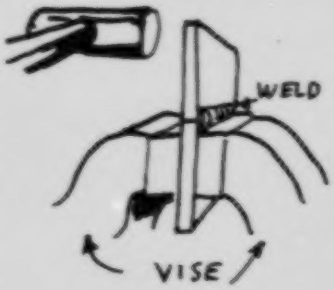
Practice safe work habits.

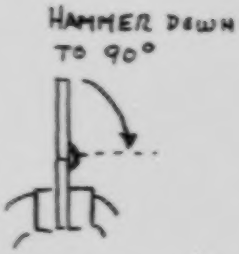
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-4-8
2. Cut it to size.	. SC-4-9
3. Align and tack weld as shown.	
4. Weld one joint without filler rod.	
5. Weld three joints with filler rod.	
6. Grind one joint.	











METHOD OF EVALUATION:

Place welded job in vise and bend 90° towards weld face with hammer to check weld soundness.

JOB: Weld a Lap Joint

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: (8) Pieces 2" x 8" x 16 Gage Black Iron
Oxygen and Acetylene
Filler Rod

EQUIPMENT: Selected by the Student

TOOLS: Basic Hand Tools

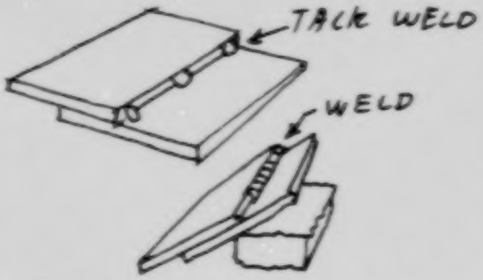
SAFETY PRECAUTIONS:

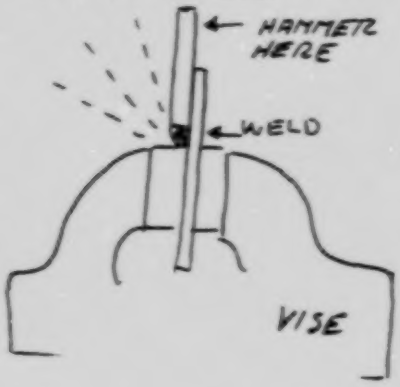
Practice safe work habits.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-12

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-4-8
2. Cut it to size.	
3. Align and tack weld as shown.	
4. Weld one joint without filler rod.	
5. Weld three joints with filler rod.	





METHOD OF EVALUATION:

Place joint in vise with weld face just above jaws of vice. Hammer against the upper plate towards weld face to check weld soundness.

JOB: Weld a T-Fillet Weld

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: (8) Pieces 2" x 8" x 16 Gage Black Iron
Oxygen and Acetylene
Filler Rod

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

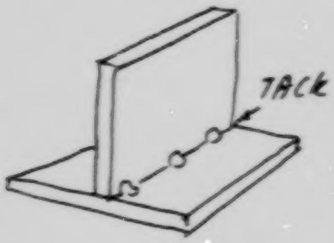
JOB SHEET IDENTIFICATION CODE

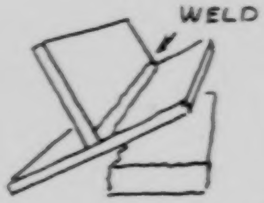
JOB NUMBER: J-4-13

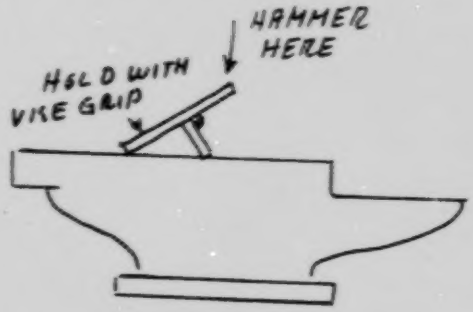
SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	. SC-4-8
3. Align and tack weld as shown.	. SC-4-9
4. Weld four joints as shown.	
5. Grind one joint.	







METHOD OF EVALUATION:

Place T joint on anvil as shown.
Flatten to show weld soundness.

JOB: Weld a Vertical Butt Joint

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-14

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: (4) Pieces 2" x 6" x 16 Gage Black Iron
Oxygen and Acetylene
Filler Rod

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

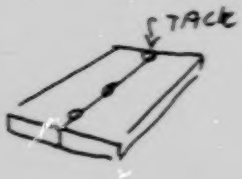
SAFETY PRECAUTIONS:

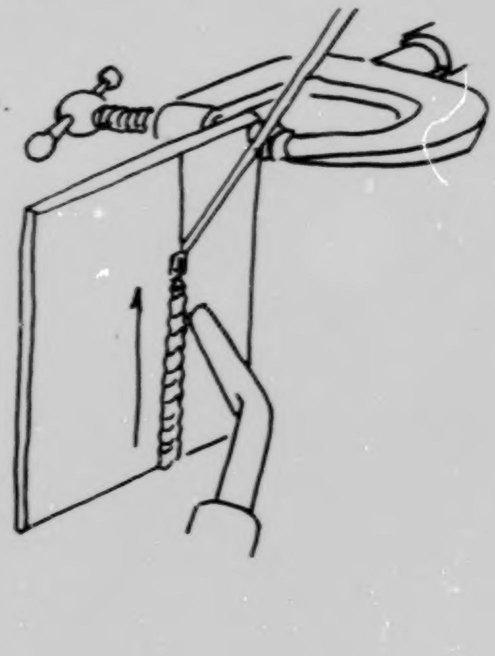
Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Select and lay out the material.
2. Cut it to size.
3. Align and tack weld as shown.
4. Weld two joints as shown.





METHOD OF EVALUATION:

Place welded job in vise and bend 90° towards weld face with hammer to check weld soundness.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-15

JOB: Weld an Overhead Butt Joint

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: (4) Pieces 2" x 6" x 16 Gage Black Iron
Oxygen and Acetylene
Filler Rod

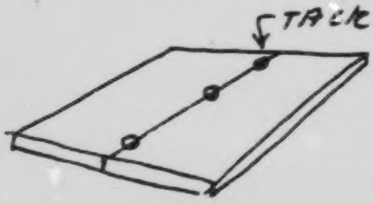
EQUIPMENT: Selected by Student

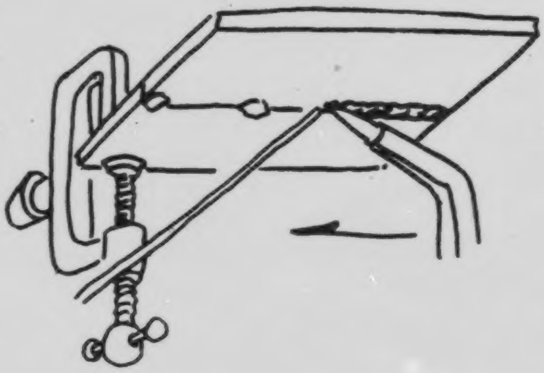
TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	
3. Align and tack weld as shown.	
4. Weld two joints as shown.	





METHOD OF EVALUATION:

Place welded job in vise and bend 90° towards the weld face with a hammer to check weld soundness.

JOB: Weld a Lap Joint, Overhead Weld

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: 4 Pieces, 2" X 6" X 16 Gage Black Iron
Oxygen and Acetylene
Filler Rod

EQUIPMENT: Selected by the Student

TOOLS: Basic Hand Tools

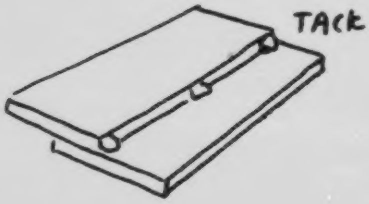
SAFETY PRECAUTIONS:

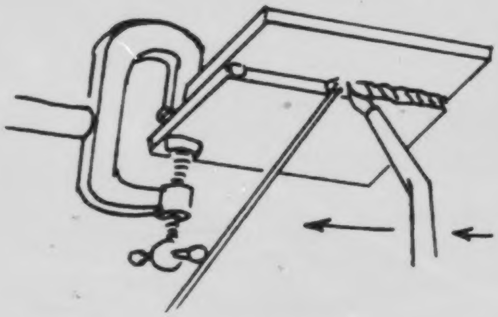
Practice safe work habits.

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-16

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	
3. Align and tack weld as shown.	
4. Weld two joints as shown.	





METHOD OF EVALUATION:

Place joint in vise with weld face just above jaws of vice. Hammer against the upper plate towards the weld face to check weld soundness.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-17

JOB: Weld a T-Fillet, Overhead Weld

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: 4 Pieces, 2" X 6" X 16 Gage Black Iron
Oxygen and Acetylene
Filler Rod

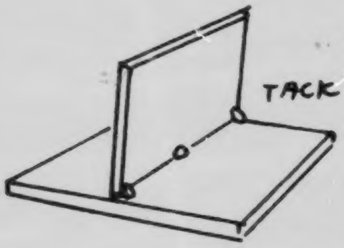
EQUIPMENT: Selected by the Student

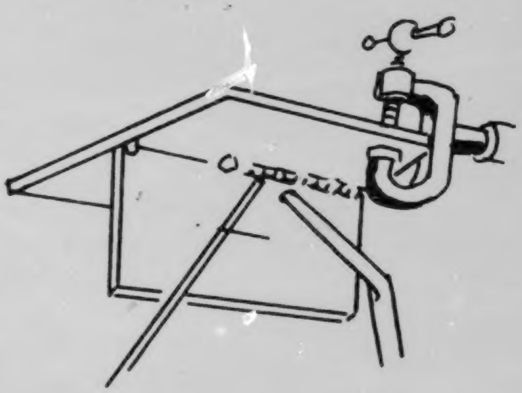
TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	
3. Align and tack weld as shown.	
4. Weld two joints as shown.	





METHOD OF EVALUATION:

Place T joint on anvil as shown.
Flatten to show weld soundness.

JOB: Braze Beads

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: (1) Piece, 4" X 8" X 16 Gage Black Iron

EQUIPMENT: Oxy-Acetylene Torch Outfit

TOOLS: Basic Hand Tools

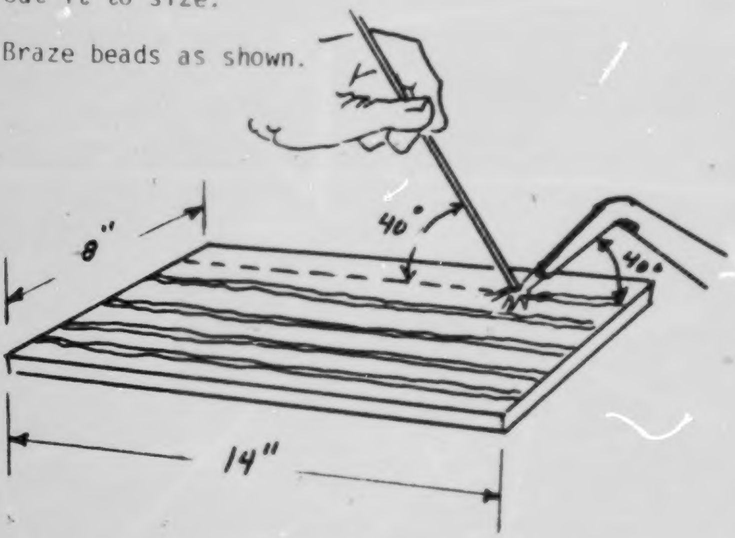
SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-18

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-4-10
2. Cut it to size.	
3. Braze beads as shown.	



METHOD OF EVALUATION:

Check beads for uniformity of height, width and ripple.
Check for proper brazing techniques and procedure.

JOB: Braze Butt Joints

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: (4) Pieces, 2" X 6" X 16 Gage Black Iron
Brazing Rod

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET
IDENTIFICATION CODE

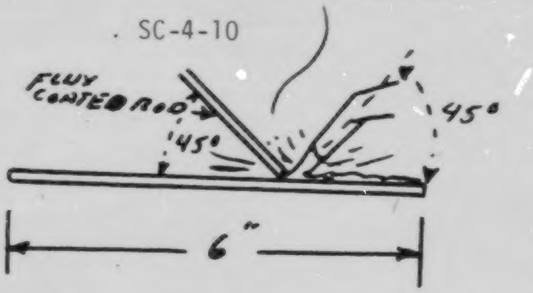
JOB NUMBER: J-4-19

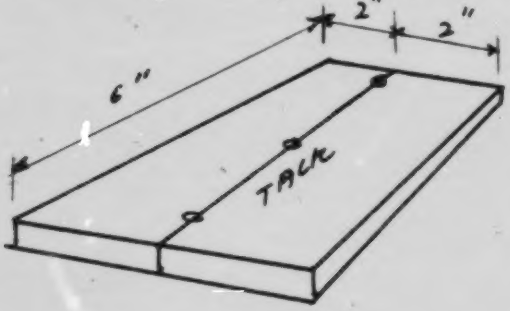
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Select and lay out the material.
2. Cut it to size.
3. Align and tack braze it.
4. Braze as shown.

. SC-4-10





METHOD OF EVALUATION:

Check joint for penetration.
Bead should be uniform in width, height, and deposition rate.

JOB: Braze a Lap Joint

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: (4) Pieces, 2" X 6" X 16 Gage Black Iron
Brazing Rod

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

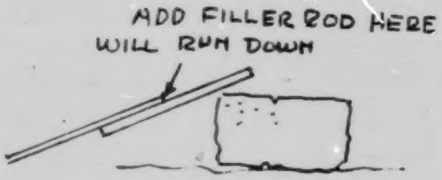
SAFETY PRECAUTIONS:

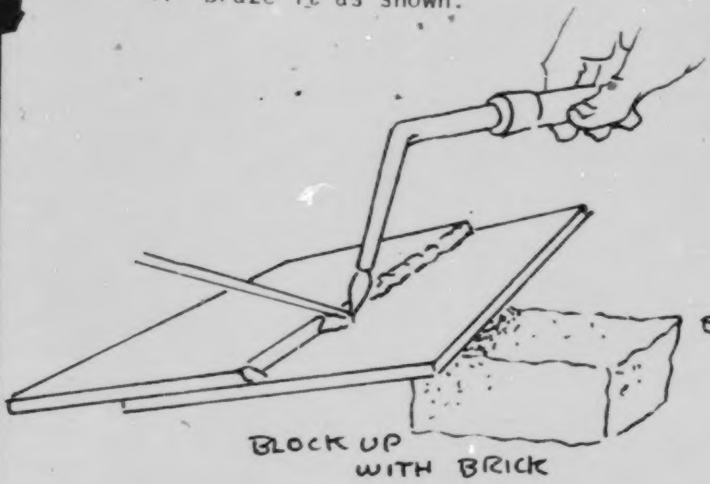
Practice safe work habits.

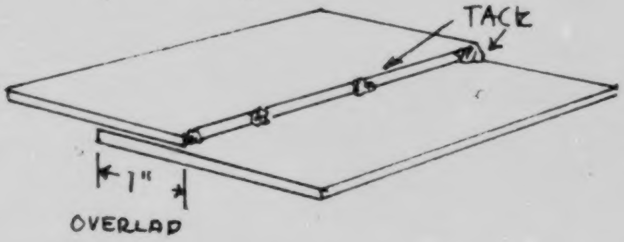
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-20

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	. SC-4-10
3. Align and tack braze it.	
4. Braze it as shown.	

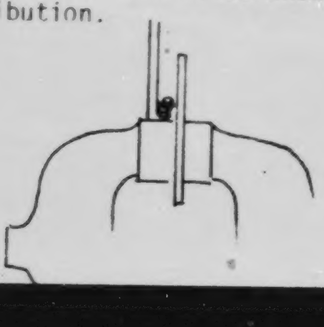

ADD FILLER ROD HERE
WILL RUN DOWN

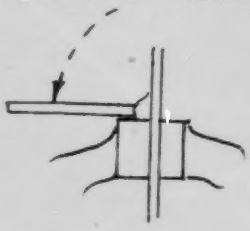

BLOCK UP
WITH BRICK


TACK
1"
OVERLAP

METHOD OF EVALUATION:

Place plates in vise as shown and break test for soundness and heat distribution.





JOB: Braze a T-Joint

UNIT IV: Welding

COURSE: Sheet Metal

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-21

MATERIAL: (4) Pieces, 2" X 6" X 16 Gage Black Iron
Brazing Rod

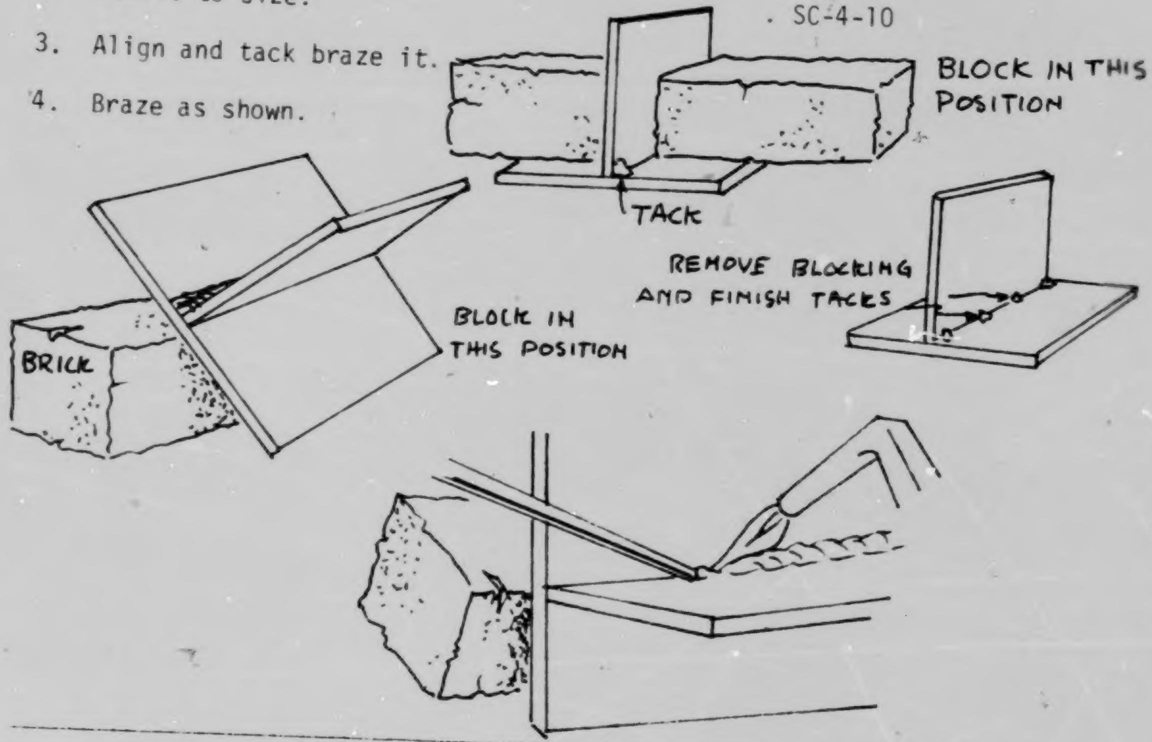
EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	
3. Align and tack braze it.	SC-4-10
4. Braze as shown.	


BLOCK IN THIS POSITION
TACK
REMOVE BLOCKING AND FINISH TACKS
BRICK
BLOCK IN THIS POSITION

METHOD OF EVALUATION:

Check bead for proper width, height, penetration and heat distribution.

JOB: Cut Pipe

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: 18" of 3/4 BLK Pipe

EQUIPMENT: Selected by Student

TOOLS: Pipe Cutter
Basic Hand Tools

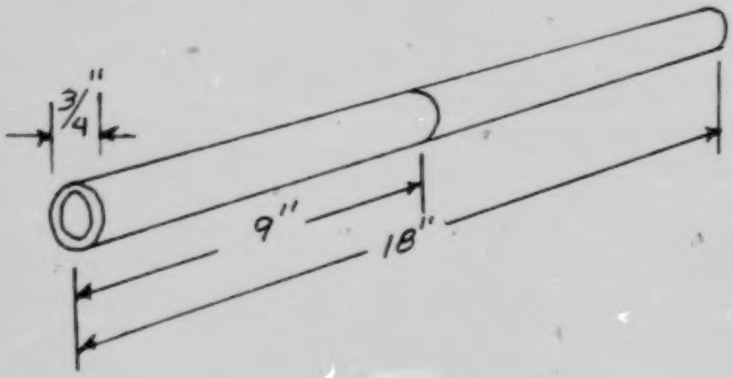
SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-22

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut two pieces of 3/4" pipe 9" long.	. SC-4-11 NOTE: Save them for the next job.



METHOD OF EVALUATION:

Check for proper pipe cutting technique and procedure.
Check cut pipe for size.

JOB: Ream Pipe

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: Use J-4-22

EQUIPMENT: Selected by Student

TOOLS: Pipe Reamer
Basic Hand Tools

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-23

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Using J-4-22, Ream the four ends of the two pipes.	. SC-4-12

METHOD OF EVALUATION:

There should be no burrs remaining inside of pipe.
Check for proper reaming techniques and procedure.

JOB:	Thread Pipe	JOB SHEET IDENTIFICATION CODE
UNIT IV:	Welding	
COURSE:	Sheet Metal	JOB NUMBER: J-4-24
MATERIAL:	Use J-4-23	
EQUIPMENT:	Selected by Student	
TOOLS:	Pipe Dies Basic Hand Tools	

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Using J-4-23, Thread the four ends of the two pipes.	. SC-4-13

METHOD OF EVALUATION:

Check for proper threading techniques and procedure.
The threads should be standard in length.

JOB:	Make a Drip Pan
UNIT IV:	Welding
COURSE:	Sheet Metal
MATERIAL:	16 Gage Black Iron 3/4" Pipe
EQUIPMENT:	Selected by Student
TOOLS:	Basic Hand Tools

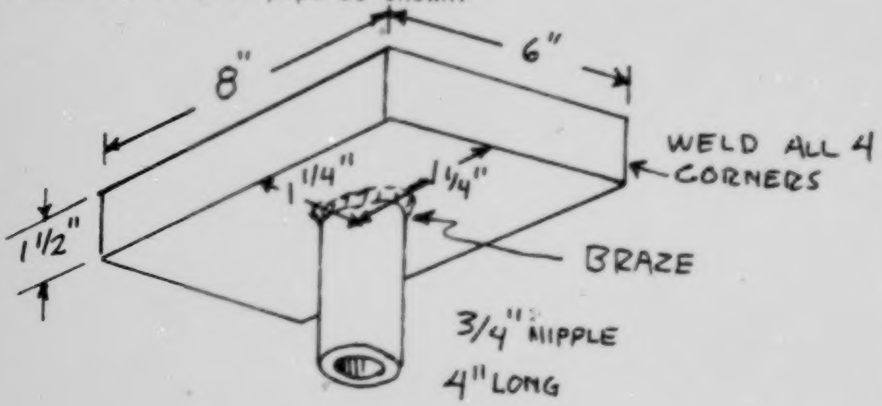
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-25

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-4-10
2. Cut it to size.	. SC-4-11
3. Bend it to the proper shape.	. SC-4-12
4. Weld the corners of the pan.	. SC-4-13
5. Braze a 3/4" x 4" pipe as shown.	



METHOD OF EVALUATION:

Check for proper assembly techniques and procedures.
The drip pan should be water tight when drain is capped.

JOB: Attach and Light a Cutting Torch

UNIT IV: Welding

COURSE: Sheet Metal

EQUIPMENT: Cutting Torch
Other Appropriate Equipment

TOOLS: Basic Hand Tools

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-26

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Attach the cutting torch.	
2. Open the oxygen and acetylene cylinders.	. SC-4-14
3. Set gage pressure for 1/4" plate.	NOTE: Use the chart to determine the correct pressure.
4. Light the cutting torch.	

METHOD OF EVALUATION:

Check for proper techniques and procedure in torch assembly.
Check for proper lighting procedure and techniques.

JOB: Flame Cut Scrap Metal

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: 1/4" Plate

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

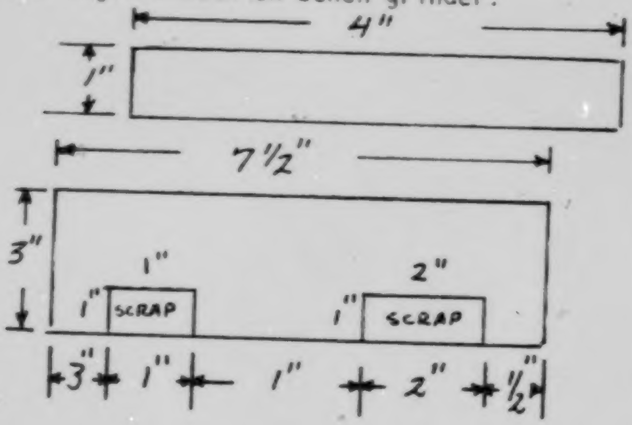
JOB SHEET
IDENTIFICATION CODE

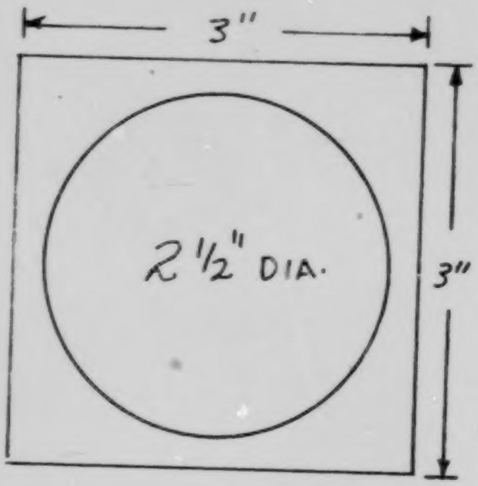
JOB NUMBER: J-4-27

SAFETY PRECAUTIONS:

Use extreme caution when grinding metal.
Hold small pieces with locking pliers.
Wear leather protective clothing and use safety shield.
When flame cutting use care in directing sparks away from tanks and other people

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-4-15
2. Flame cut it to size.	. SC-4-15A
3. Grind edges smooth on bench grinder.	. SC-4-16





METHOD OF EVALUATION:

Check for proper flame cutting techniques and procedures.
Check for proper grinding.

JOB: Make a Square Offset

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-28

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: 18 Gage Black Iron

EQUIPMENT: AC-DC Arc Welder
Welding Hood
Protective Leather Clothing

TOOLS: Basic Hand Tools

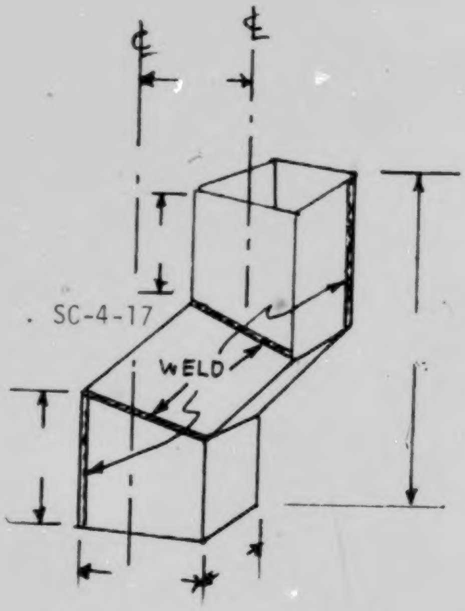
SAFETY PRECAUTIONS:

Prevent electric shock by wearing gloves and staying clear of wet work area.
Wear proper shield and shielding glass.
Wear protective clothing.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Select and lay out the material.
2. Cut it to size.
3. Bend it to shape.
4. Practice arc welding basic joints in flat position.
5. Check with instructor.
6. Weld it together as shown with electric arc welder.

. SC-4-17



METHOD OF EVALUATION:

Check for proper arc welding techniques and procedure.
Check basic joints before allowing student to weld actual job.
Check beads for uniformity and soundness.
Check overall dimensions, appearance and alignment of offset.
Check for proper assembly procedure and techniques.

JOB: Make a Round Offset Joint

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: 18 Gage Black Iron
E-6010 Electrodes

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

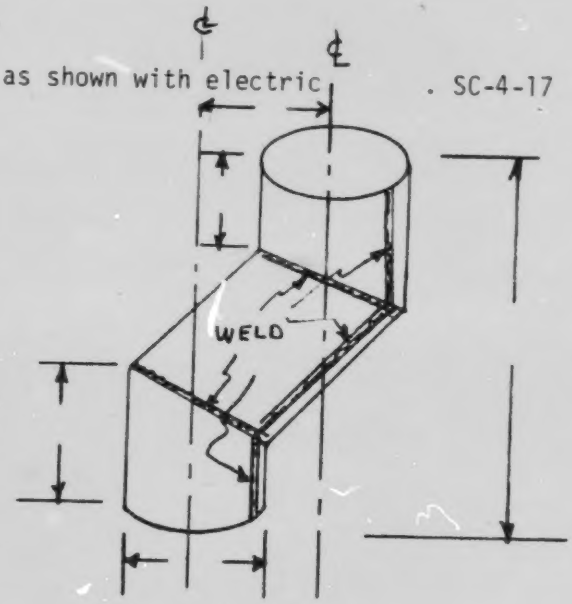
SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-29

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	
3. Bend it to shape.	
4. Weld it together as shown with electric arc.	. SC-4-17



METHOD OF EVALUATION:

Check for proper welding techniques and procedure.
Check weld beads for uniformity and soundness.
Check overall dimension appearances and alignment of offset.
Check for proper assembly procedure and techniques.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-30

JOB: Make a Square Transition

Unit IV: Welding

COURSE: Sheet Metal

MATERIAL: 18 Gage Black Iron
1/16" Tungsten Electrode
Argon Gas

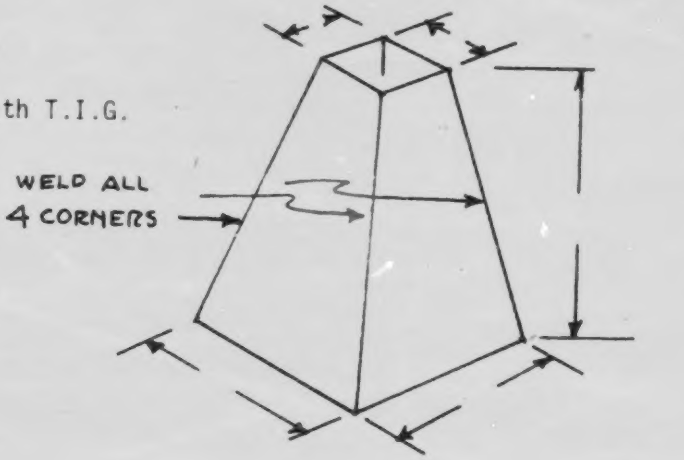
EQUIPMENT: T.I.G. Arc Welder
T.I.G. Torch

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	. SC-4-18
3. Bend it to shape.	
4. Practice T.I.G. welding basic joints in flat position.	NOTE: Check with instructor.
5. Weld it together as shown with T.I.G.	



METHOD OF EVALUATION:

Check practice joints before allowing job to be welded.
Check overall dimensions and appearance of job.
Check proper T.I.G. welding techniques and procedure.
Check weld beads for uniformity and soundness.

JOB: Fabricate a Taper Square Intersecting a Round Pipe

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-31

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL:
18 Gage Black Iron
Tungsten Electrode
Filler Rod
Argon Gas

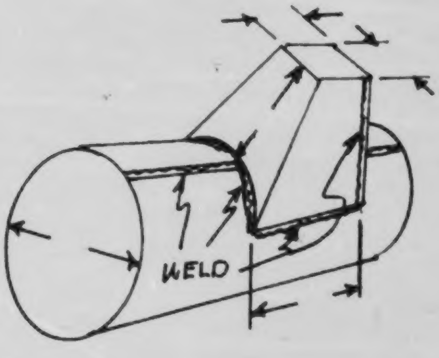
EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	
3. Bend it to shape.	. SC-4-18
4. Weld it together as shown with T.I.G.	



METHOD OF EVALUATION:

Check overall dimensions and appearances of job.
Check weld beads for uniformity and soundness.
Check for proper T.I.G. welding techniques and procedure.

JOB SHEET
IDENTIFICATION CODE

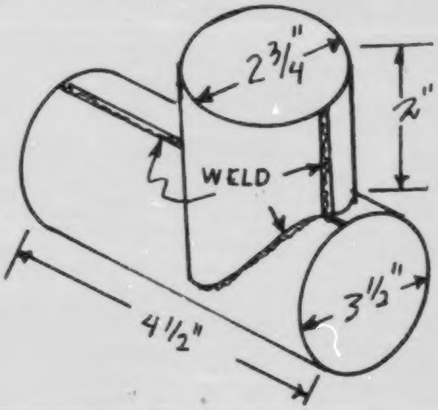
JOB NUMBER: J-4-32

JOB:	Fabricate a Round Tee
UNIT IV:	Welding
COURSE:	Sheet Metal
MATERIAL:	14 Gage Black Iron .030 Mild Steel M.I.G. Wire .030 Contact TIP CO_2 Gas
EQUIPMENT:	M.I.G. Welder Leather Clothing
TOOLS:	Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	
3. Bend it to shape.	
4. Practice M.I.G. welding basic joints flat position.	NOTE: Check with instructor. . SC-4-18
5. Weld it together as shown with M.I.G.	



METHOD OF EVALUATION:

Check practice joints before starting job.
Check for proper M.I.G. welding techniques and procedure.
Check overall dimensions and appearance of job.
Check weld beads for soundness and uniformity.

JOB: Fabricate a Round "Y" Branch

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Welding

COURSE: Sheet Metal

JOB NUMBER: J-4-33

MATERIAL: 16 Gage Black Iron
.030 Mild Steel
M.I.G. Wire
.030 Contact TIP
CO_2 Gas

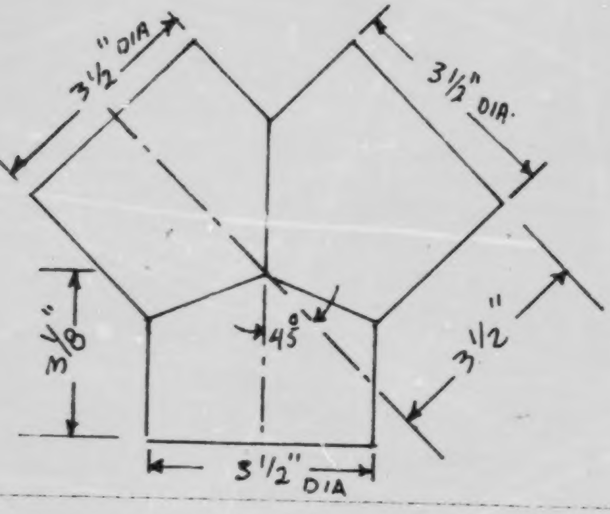
EQUIPMENT: Selected by Student

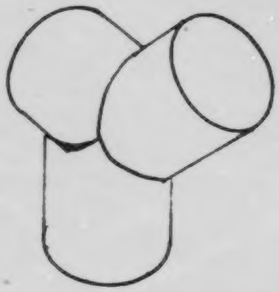
TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	
3. Bend it to shape.	. SC-4-19
4. Weld it together as shown with M.I.G.	





METHOD OF EVALUATION:

Check practice joints before starting job.
Check for proper M.I.G. welding techniques and procedure.
Check overall dimensions and appearance of job.
Check weld beads for soundness and uniformity.

JOB: Fabricate a Round Pipe Intersecting a Round Transition

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-34

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: 18 Gage Black Iron
Tungsten Electrode Filler Rod
Argon Gas

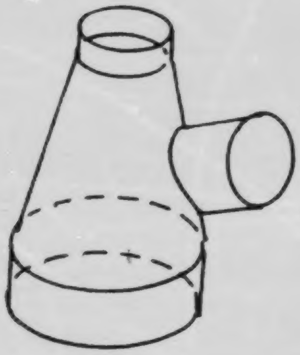
EQUIPMENT: Selected by Student

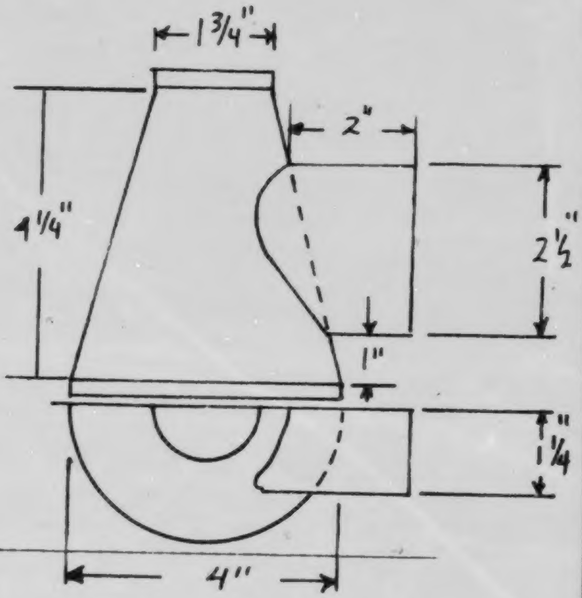
TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	. SC-4-19
3. Bend it to shape.	
4. Weld it together as shown with T.I.G.	





METHOD OF EVALUATION:

Check for proper overall dimensions and appearance.
Check for proper assembly techniques and procedure.
Check Time to complete job.

JOB: Make a Square-to-Round Duct

UNIT IV: Welding

COURSE: Sheet Metal

MATERIAL: 18 Gage Black Iron
E-6013 Electrodes

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

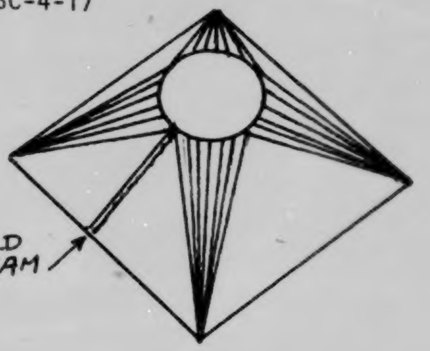
SAFETY PRECAUTIONS:

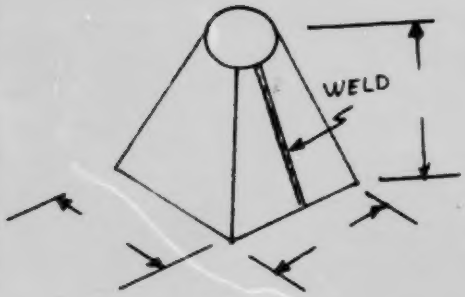
Practice safe work habits.

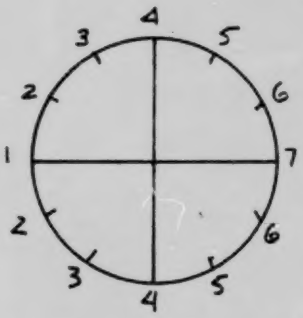
JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-4-35

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-4-17
2. Cut it to size.	
3. Bend it to shape.	
4. Weld it together as shown with electric arc.	







METHOD OF EVALUATION:

Check overall appearance and size of job.
Check for proper assembly procedure and technique.
Check amount of time to complete job.

JOB: Form a Pittsburgh Lock on the Brake

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-1

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

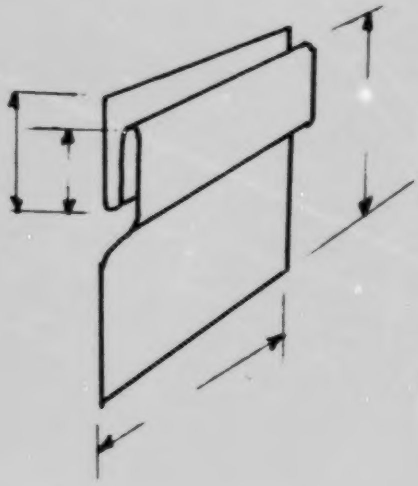
EQUIPMENT: Cornice Brake and Other Appropriate Equipment

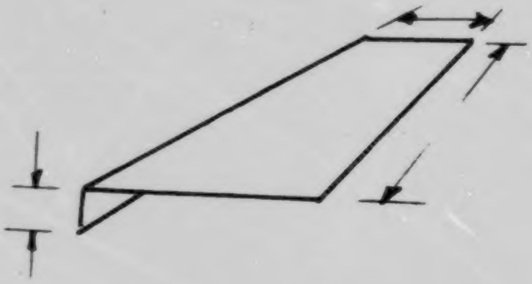
TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	
2. Cut it to size.	. SC-5-1
3. Form the lock on the cornice brake.	. SC-5-2





METHOD OF EVALUATION:

Check for proper Pittsburgh lock forming procedure and techniques when using cornice brake.
Check for flushness of outside of lock.
Check lock for uniformity in depth.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-2

JOB: Form a Pittsburgh Lock on the Lock Former

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

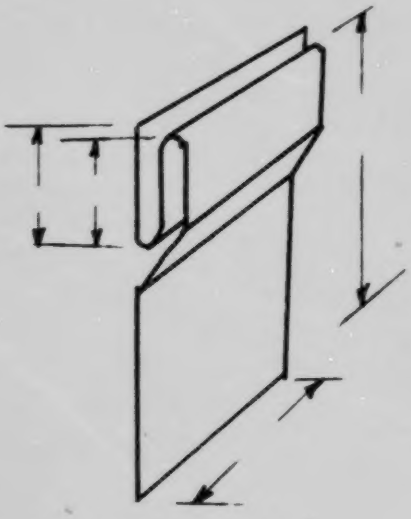
EQUIPMENT: Pittsburgh Lock Former
Other Appropriate Equipment

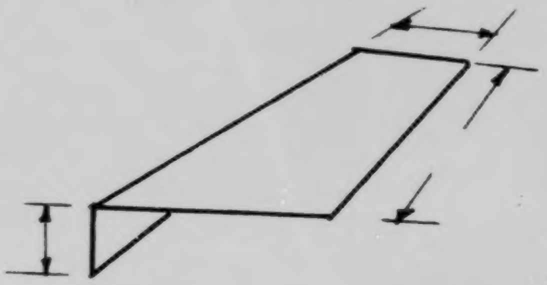
TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

The lock former will shape metal.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-5-2
2. Cut it to size.	. SC-5-3
3. Form the lock on the Pittsburgh lock former.	





METHOD OF EVALUATION:

Check for proper lock forming procedure and techniques.
Check for tightness of sheet to lock forming guides.
Check lock for uniformity of size of pocket flange.

JOB: Make a Square Duct

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Pittsburgh Lock Former
Other Appropriate Equipment

TOOLS: Basic Hand Tools

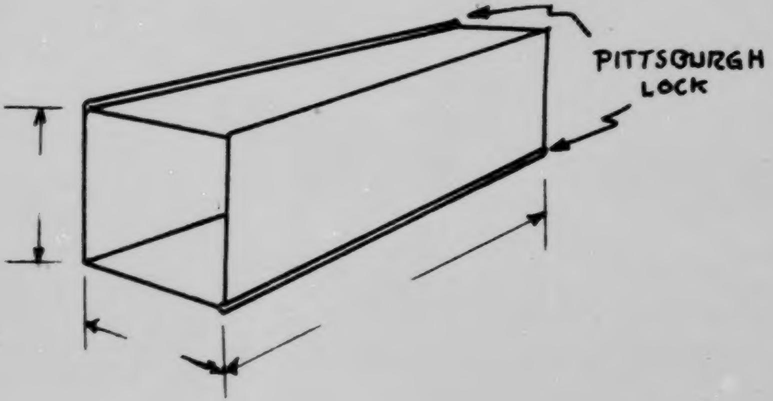
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-3

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-5-2
2. Cut it to size.	. SC-5-3
3. Form the Pittsburgh lock.	
4. Bend the duct to shape.	
5. Assemble the duct as shown.	



METHOD OF EVALUATION:

Check for proper assembly procedures and techniques.
There should be no hammer marks on the duct.
There should be no buckles or kinks in the formed pocket flange.
The ends of the duct should be squared and aligned with each other.

JOB: Make Two Rectangular Ducts

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Cleat Bender
Other Appropriate Equipment

TOOLS: Basic Hand Tools

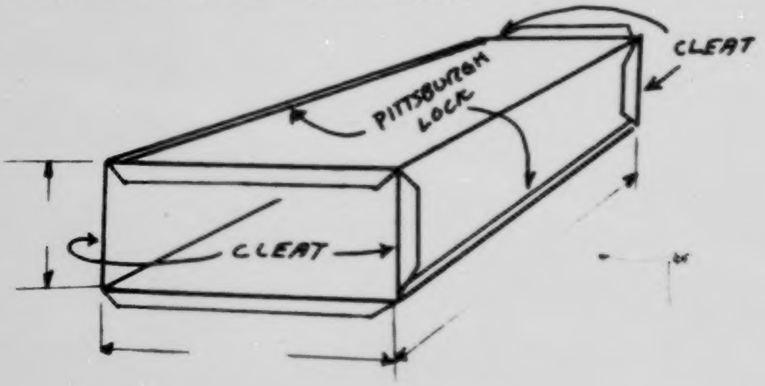
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-4

SAFETY PRECAUTIONS:

The cleat bender is an excellent place to pinch your fingers; be careful.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-5-3
2. Cut it to size.	. SC-5-4
3. Form the Pittsburgh lock.	
4. Shape and assemble the duct.	
5. Bend the cleats in the cleat bender.	



METHOD OF EVALUATION:

Check for proper cleat forming procedure and technique.
The cleat should be uniform in size with enough clearance to accept the drive cleat.

JOB: Fabricate an S-Cleat

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Bar Folder and Other Appropriate Equipment

TOOLS: Basic Hand Tools

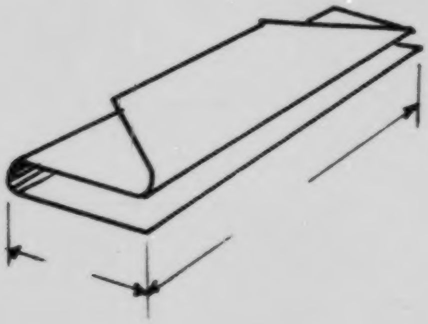
SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-5

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-5-5
2. Cut it to size.	
3. Form an S-cleat on bar folder.	



METHOD OF EVALUATION:

Check for proper bar folder procedure and technique.
The cleat should be uniform in width and length, and tight enough to accept duct but not allow leakage or noise.

JOB: Fabricate a Drive Cleat

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Bar Folder
Other Appropriate Equipment

TOOLS: Basic Hand Tools

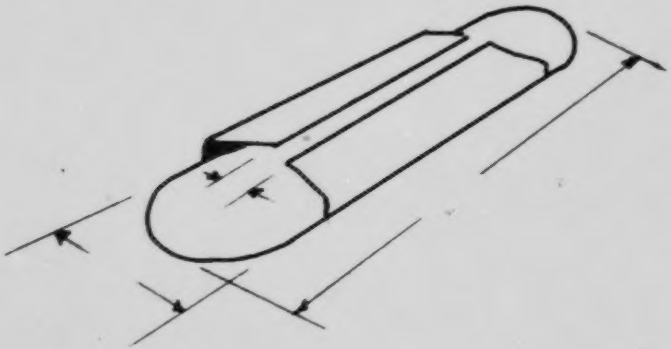
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-6

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-5-6
2. Cut it to size.	
3. Form drive cleat on the bar folder.	



METHOD OF EVALUATION:

The drive cleat should be uniform in width and length.
The drive cleat center clearance should be wide enough to fit over the duct cleats and hold duct securely with no leakage.

JOB: Use J-5-5 and J-5-6 and Connect the Two Ducts in J-5-4

JOB SHEET
IDENTIFICATION CODE

UNIT V: Duct Fittings

JOB NUMBER: J-5-7

COURSE: Sheet Metal

MATERIAL: 28 Gage Galvanized Iron

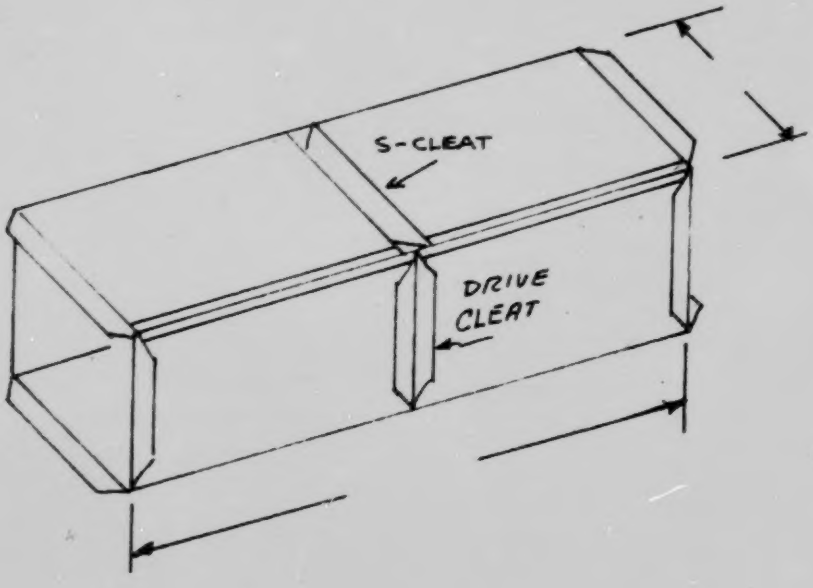
EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Assemble duct as shown.	. SC-5-7



METHOD OF EVALUATION:

Check for proper assembly techniques and procedure.
There should be no place for air leakage, there should be no movement between the ducts.

JOB: Fabricate a 90° Rectangular Duct Elbow

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Cornice Brake
Other Appropriate Equipment

TOOLS: Basic Hand Tools

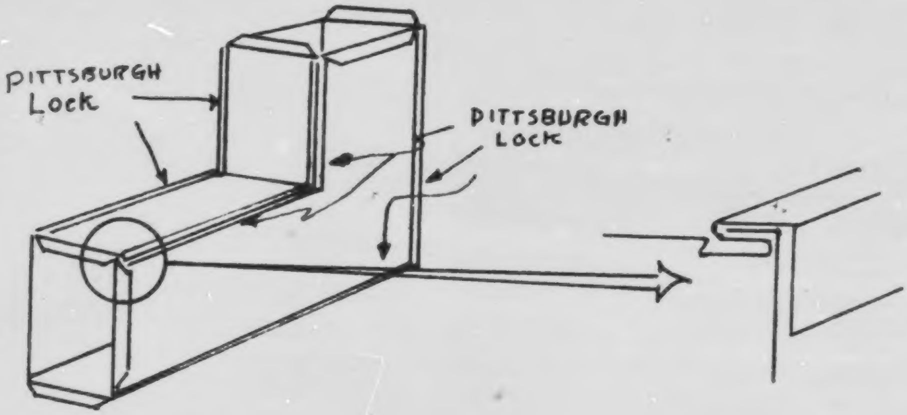
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-8

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-5-4
2. Cut it to size.	. SC-5-5
3. Form Pittsburgh locks.	. SC-5-6
4. Cross brake in the cornice brake.	. SC-5-7
5. Shape in the cornice brake.	. SC-5-8
6. Assemble as shown.	



METHOD OF EVALUATION:

Check for proper depth and placement of cross brake.
Check for proper assembly techniques and procedure.
The duct should be free of twist and the ends even.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-9

JOB: Make a 90° Rectangular Duct Elbow
Radius Heal

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

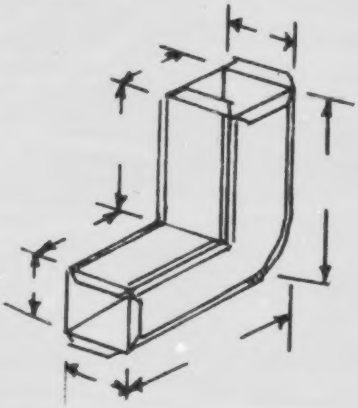
EQUIPMENT: Easy Edger
Other Appropriate Equipment

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-5-4
2. Cut it to size.	. SC-5-5
3. Cross brake.	. SC-5-6
4. Form 1/4" edge on easy edger.	. SC-5-7
5. Form Pittsburgh lock.	. SC-5-8
6. Assemble as shown.	. SC-5-9



METHOD OF EVALUATION:

Check for proper depth and placement of cross brake.
Check for proper assembly techniques and procedure.
The duct should be free of twist and the ends even.
Check for proper easy edging techniques and procedure.

JOB: Fabricate a 90° Rectangular Duct Elbow Radius Throat and Heel

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-10

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

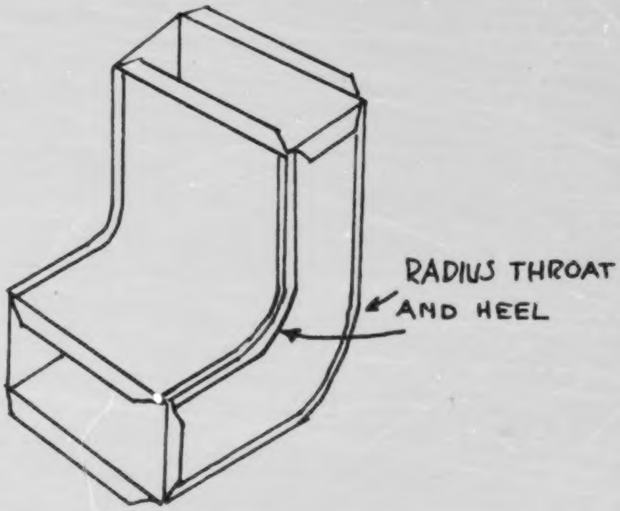
EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out the material.	. SC-5-8
2. Cut it to size.	. SC-5-9
3. Cross brake.	
4. Form 1/4" edge on easy edger.	
5. Form Pittsburgh lock.	
6. Assemble as shown	



METHOD OF EVALUATION:

Check for proper easy edger techniques and procedure.
Duct should be aligned at ends with no twist.

JOB: Fabricate a 45° Rectangular Duct Square Throat and Heel

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-11

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

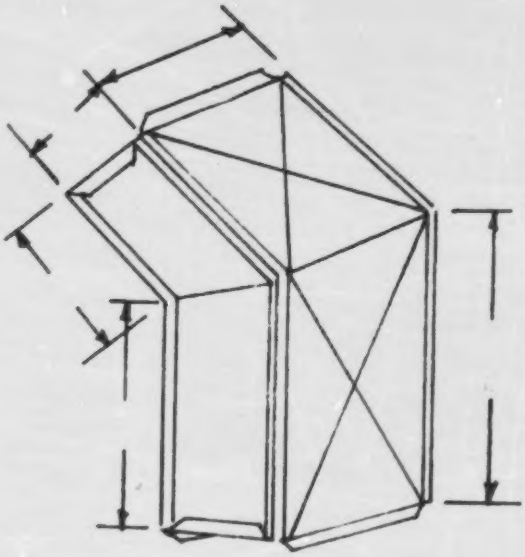
EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	. SC-5-9
2. Cut to size.	
3. Cross brake.	
4. Shape duct.	
5. Assemble as shown.	



METHOD OF EVALUATION:

Check overall dimensions and appearance.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-12

JOB: Fabricate a 45° Rectangular Duct Radius Throat and Heel

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

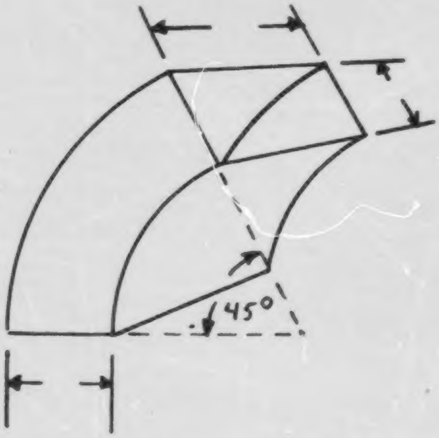
EQUIPMENT: Shop Master and Other Appropriate Equipment

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	. SC-5-10
2. Cut to size.	
3. Shape duct.	
4. Assemble as shown.	



METHOD OF EVALUATION:

Check for proper procedure and techniques on shop master unit.
Check for accuracy of overall dimensions.
Check for overall appearance.

JOB: Fabricate a 45° Brodway Elbow

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

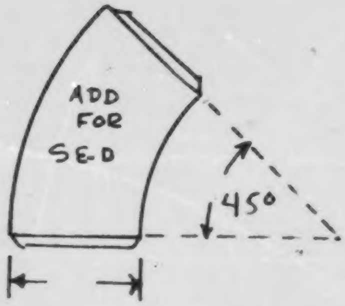
SAFETY PRECAUTIONS:

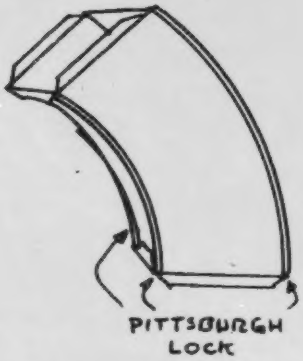
Practice safe work habits.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-13

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	. SC-5-10
2. Cut to size.	. SC-5-11
3. Shape duct.	
4. Assemble as shown.	





METHOD OF EVALUATION:

Check for proper notching techniques and procedure.
Check overall accuracy and appearance.

JOB: Make a 90° Brodway Elbow

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Hand Nibbler
Other Appropriate Equipment

TOOLS: Basic Hand Tools

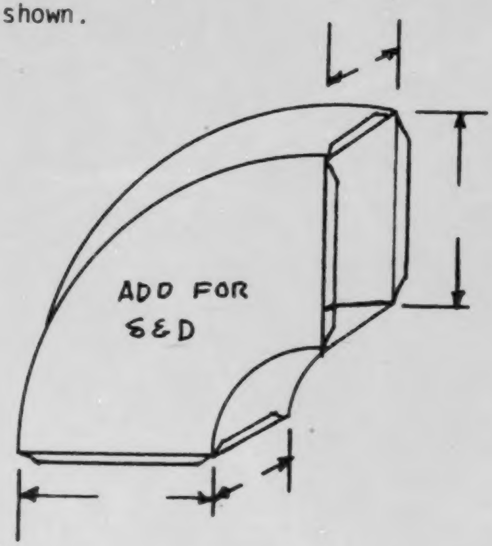
SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-14

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	. SC-5-10
2. Cut to size.	. SC-5-11
3. Shape duct.	. SC-5-12
4. Assemble as shown.	



METHOD OF EVALUATION:

Check for proper nibbler techniques and procedure.
Check for overall accuracy.
Check for overall appearance.

JOB: Make a Square Duct Tap

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

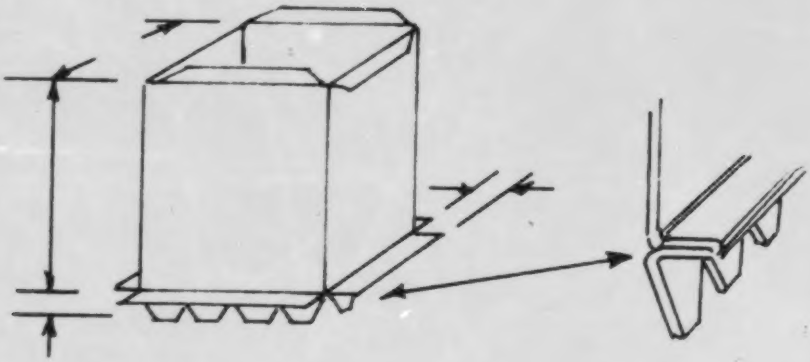
SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-15

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	. SC-5-12
2. Cut to size.	. SC-5-13
3. Shape duct and tap-in.	
4. Cut starting slot in duct to install tap-in.	. SC-5-14
5. Install tap-in.	



METHOD OF EVALUATION:

Check for proper slot cutting technique.
Check for proper tap in assembly techniques and procedure.
Check for accuracy and appearance of job.

JOB: Make a Round Duct Tap

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-16

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	. SC-5-12
2. Cut to size.	. SC-5-13
3. Form pipe and seam.	. SC-5-14
4. Form bead for tap-in.	NOTE: This lock is sometimes referred to as a dovetail seam.
5. Notch tap-in or dovetail.	
6. Assemble tap-in into duct.	

METHOD OF EVALUATION:

Check for assemble techniques and procedure.
Check for proper dimensions and appearance.

JOB: Fabricate a Rectangular Transition Duct Tap

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Select by Student

TOOLS: Basic Hand Tools

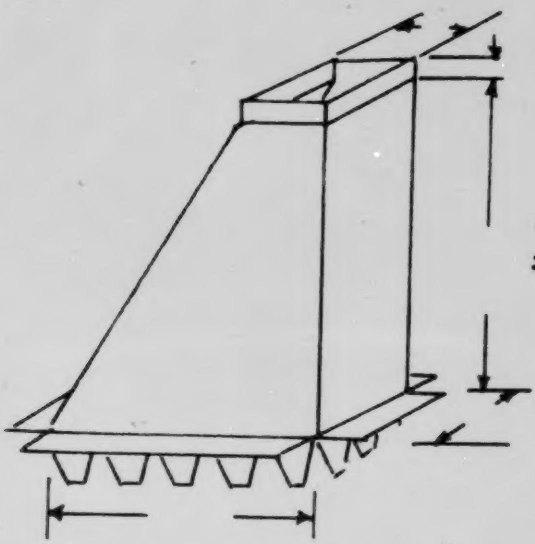
JOB SHEET
IDENTIFICATION SHEET

JOB NUMBER: J-5-17

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	. SC-5-11
2. Cut to size.	
3. Shape duct.	
4. Assemble as shown.	



ADD FOR
S.E.D

METHOD OF EVALUATION:

Check overall accuracy and appearance.
Check for proper assembly procedures and techniques.

JOB:	Make a Rectangular Transition Duct Tap (Sweep)	JOB SHEET IDENTIFICATION CODE
UNIT V:	Duct Fittings	JOB NUMBER: J-5-18
COURSE:	Sheet Metal	

MATERIAL: 26 Gage Galvanized Iron

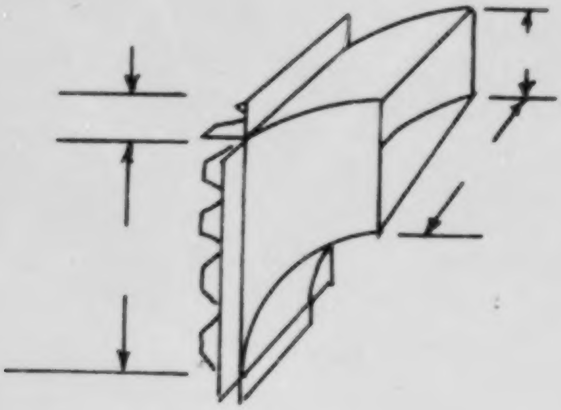
EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	
2. Cut to size.	
3. Shape duct.	
4. Assemble as shown.	



METHOD OF EVALUATION:

Check for proper overall accuracy and appearance.

JOB:	Make a Register Box
UNIT V:	Duct Fittings
COURSE:	Sheet Metal
MATERIAL:	26 Gage Galvanized Iron
EQUIPMENT:	Selected by Student
TOOLS:	Basic Hand Tools

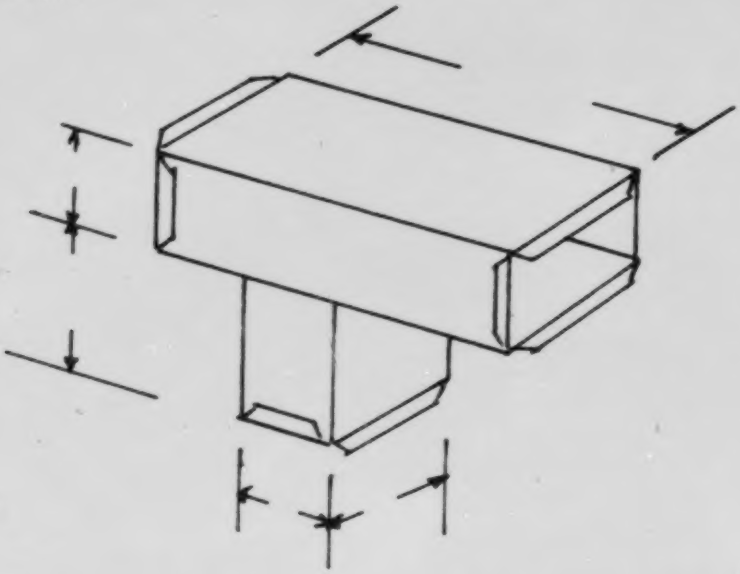
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-19

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	
2. Cut to size.	
3. Shape duct.	
4. Assemble as shown.	



METHOD OF EVALUATION:

Check for proper overall accuracy and appearance.
Check amount of time used.

JOB: Fabricate a Y-Branch

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

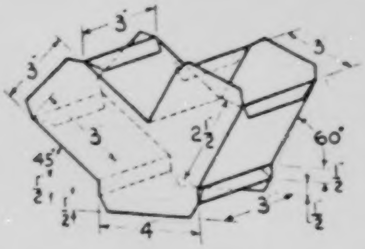
Practice safe work habits.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-20

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Select and lay out material.
2. Cut to size.
3. Shape duct.
4. Assemble as shown.



METHOD OF EVALUATION:

Check for overall accuracy and appearance.
Check for time used.

JOB: Fabricate a Y-Branch Offset

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

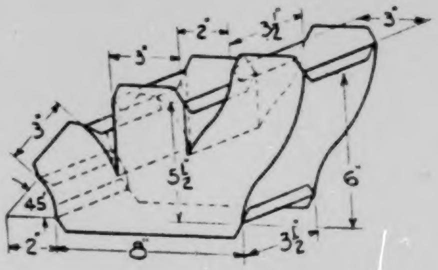
SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-21

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	
2. Cut to size.	
3. Shape duct.	
4. Assemble as shown.	



METHOD OF EVALUATION:

Check Pittsburgh Lock assembly at "V" in Y-Branch for proper assembly. Check overall accuracy and appearance.

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-22

JOB: Assemble Two Ducts to J-5-21

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

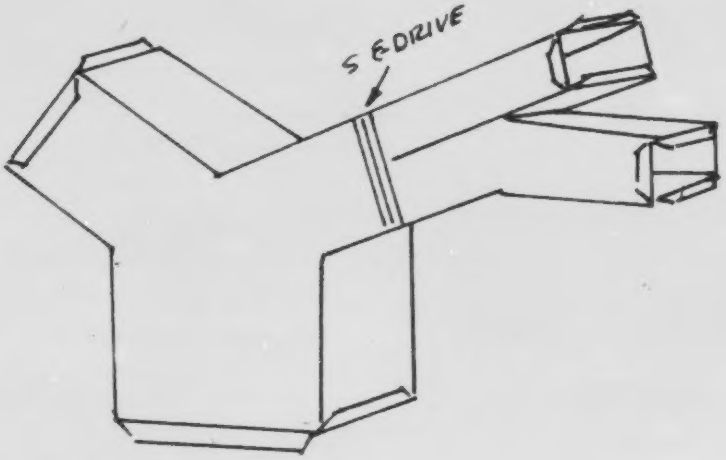
EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Fabricate a straight duct and 45° elbow sized so that when placed together it will fit onto J-5-20.	
2. Assemble as shown.	



METHOD OF EVALUATION:

Check for proper assembly procedure and techniques.
Check overall accuracy and appearance.

JOB: Make a Rectangular Transition

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

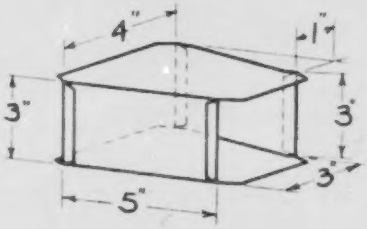
SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-23

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	
2. Cut to size.	
3. Shape duct.	
4. Assemble as shown.	



METHOD OF EVALUATION:

Check for overall accuracy and appearance.

JOB: Make a Rectangular Transition

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selection by Student

TOOLS: Basic Hand Tools

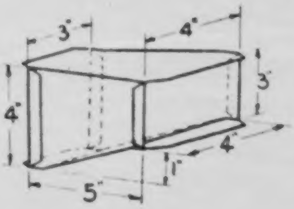
SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-24

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	
2. Cut to size.	
3. Shape duct.	
4. Assemble as shown.	



METHOD OF EVALUATION:

Check overall accuracy and appearance.

JOB SHEET
IDENTIFICATION CODE

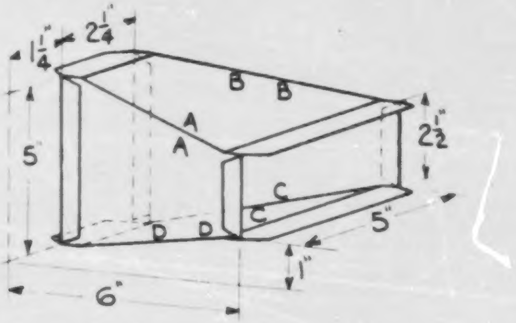
JOB NUMBER: J-5-25

JOB: Make a Rectangular Transition
UNIT V: Duct Fittings
COURSE: Sheet Metal
MATERIAL: 26 Gage Galvanized Iron
EQUIPMENT: Selected by Student
TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	
2. Cut to size.	
3. Shape duct.	
4. Assemble as shown.	



METHOD OF EVALUATION:

Check overall accuracy and appearance.

JOB: Make a Transition Y-Branch

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

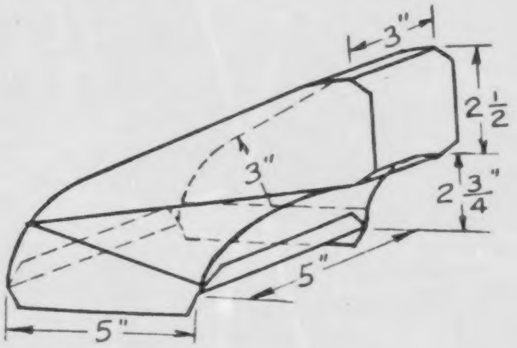
SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-26

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	
2. Cut to size.	
3. Shape duct.	
4. Assemble as shown.	



METHOD OF EVALUATION:

Check overall accuracy and appearance.

JOB: Make a Change Transition

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

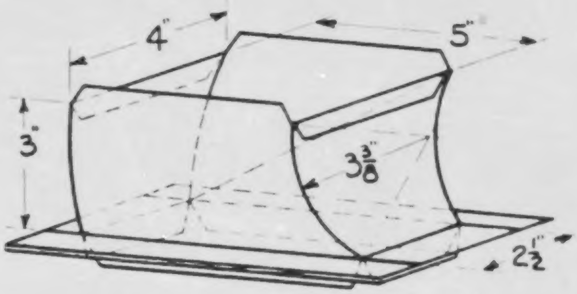
JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-27

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Select and lay out material.
2. Cut to size.
3. Shape duct.
4. Assemble as shown.



METHOD OF EVALUATION:

Check overall accuracy and appearance.

JOB: Make a Change Transition

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

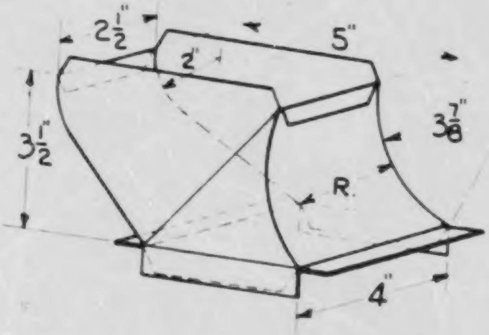
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-28

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Select and lay out material.
2. Cut to size.
3. Shape duct.
4. Assemble as shown.



METHOD OF EVALUATION:

Check overall accuracy and appearance.

JOB: Make a 45° Twist

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET IDENTIFICATION CODE

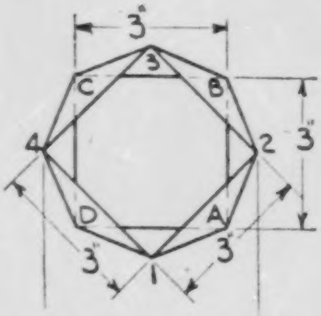
JOB NUMBER: J-5-29

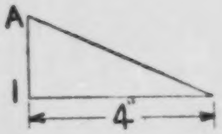
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

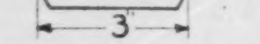
1. Select and lay out material.
2. Cut to size.
3. Shape duct.
4. Assemble as shown.

❷ PLAN VIEW

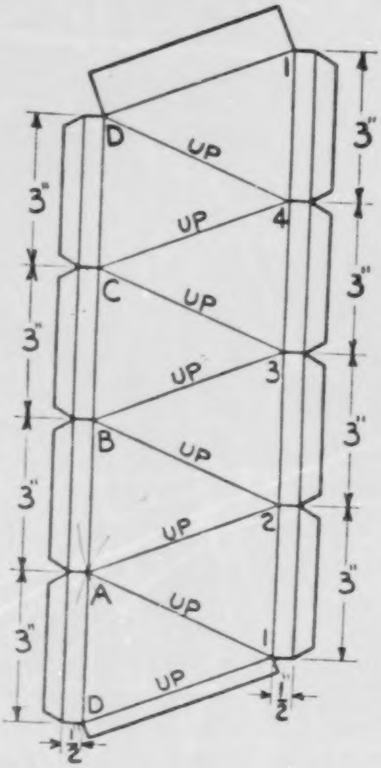

3"
3
C
B
4
2
3"
D
A
3"
3"
1



❸ TRUE LENGTHS



❶ ELEVATION


1
D
UP
3"
3"
UP
4
3"
C
UP
3"
3"
UP
3
B
UP
3"
3"
UP
2
A
UP
3"
3"
1
UP
D
1/2"
1/2"

❹ PIPE PATTERN

METHOD OF EVALUATION:

Check overall accuracy and appearance of twist.

JOB: Make a Twist and Offset Duct Fitting

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET IDENTIFICATION CODE

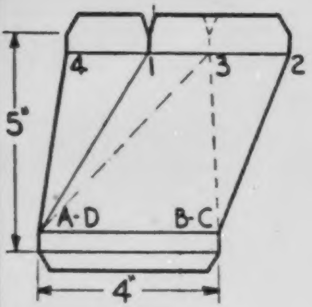
JOB NUMBER: J-5-30

DRAWING NO: D-5-30

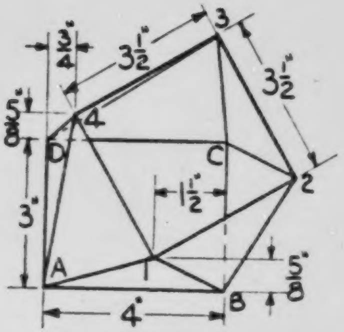
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	
2. Cut to size.	
3. Shape duct.	
4. Assemble as shown.	

METHOD OF EVALUATION:

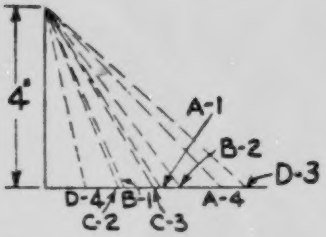
Check overall accuracy and appearance.


4
1
3
2
5"
A-D
B-C
4"

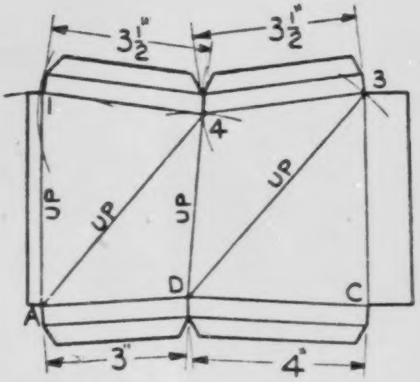
❶ ELEVATION


3/4"
3 1/2"
3
3 1/2"
5/8"
4
D
C
2
1 1/2"
3"
1
A
B
5/8"
4"

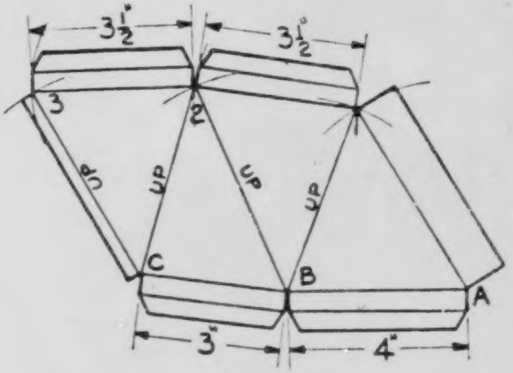
❷ PLAN VIEW


4"
A-1
B-2
D-3
D-4
B-1
A-4
C-2
C-3

❸ TRUE LENGTHS


3 1/2"
3 1/2"
1
4
3
UP
UP
UP
UP
A
D
C
3"
4"

❹ HALF PATTERN


3 1/2"
3 1/2"
3
2
UP
UP
UP
UP
C
B
A
3"
4"

❺ HALF PATTERN

TWIST AND OFFSET DUCT FITTINGS

DRAWING NUMB

D-5-30

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-31

JOB: Make an Offset Duct Fitting

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

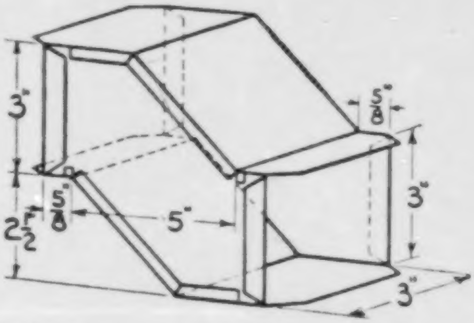
TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Select and lay out material.
2. Cut to size.
3. Shape duct.
4. Assemble as shown.



③ PERSPECTIVE VIEW

METHOD OF EVALUATION:

Check overall accuracy and appearance.

JOB: Make an Offset Duct Fitting

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

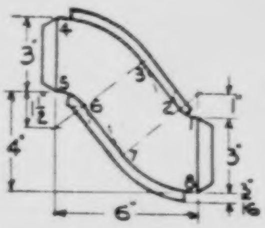
JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-32

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

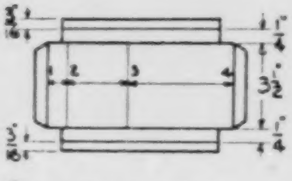
TEACHING/LEARNING ACTIVITIES

1. Select and lay out material.
2. Cut to size.
3. Shape duct.
4. Assemble as shown.



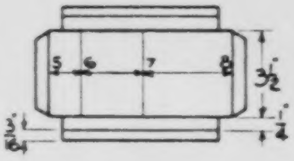
3"
4
5
3
1½"
6
2
1"
4"
7
3"
8
5/16
6"

❶ CHEEK PATTERN



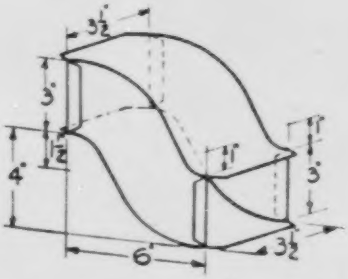
3/16
1"/4
1
2
3
4
3½"
1"/4
3/16

❷ HEEL PATTERN



5
6
7
8
3½"
3/16
1"/4

❸ HEEL PATTERN



3½"
3"
1½"
4"
1"
1"
3"
6"
3½"

❹ PERSPECTIVE VIEW

METHOD OF EVALUATION:

Check overall accuracy and appearance.

JOB: Make a Change Offset

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

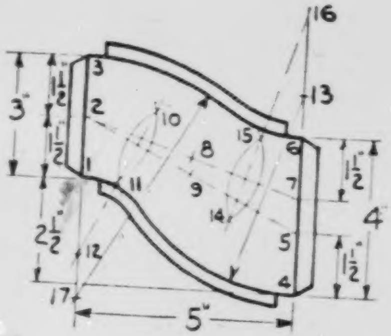
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-33

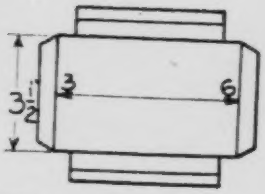
SAFETY PRECAUTIONS:

Practice safe work habits.

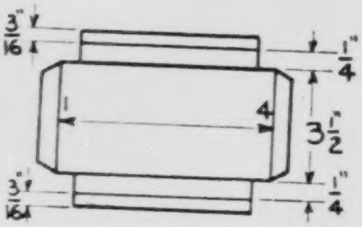
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	
2. Cut to size.	
3. Shape duct.	
4. Assemble as shown.	


16
13
3"
1½
1½
3
2
1
10
8
9
11
15
6
7
14
1½
4
5
1½
4
2½
12
17
5"

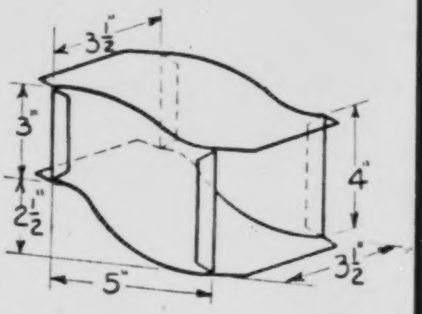
❶ CHEEK PATTERN



❸ HEEL PATTERN


3"/16
¼"
1
4
3½
3"/16
¼"

❷ HEEL PATTERN



❹ PERSPECTIVE VIEW

METHOD OF EVALUATION:

Check overall accuracy and appearance.

JOB: Make a Change Elbow

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

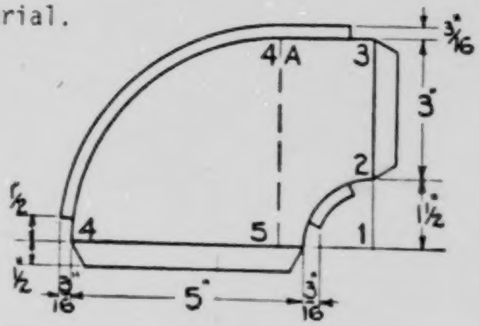
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-34

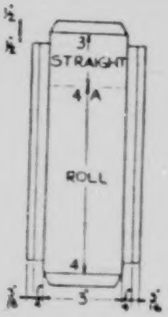
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

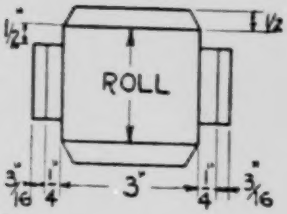
1. Select and lay out material.
2. Cut to size.
3. Shape duct.
4. Assemble as shown.


4
A
3
3/16"
3"
2
1 1/2"
1/2"
4
5
1
1/2"
3/16"
5"
3/16"

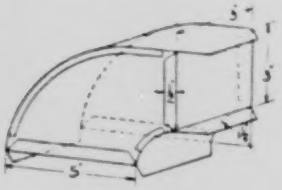
❶ LAYING OUT CHEEK PATTERN


3"
STRAIGHT
4
A
ROLL
4
5

❸ HEEL PATTERN


1/2"
1/2
ROLL
3/16"
1/4"
3"
1/4"
3/16

❷ THROAT PATTERN



❹ PERSPECTIVE VIEW

METHOD OF EVALUATION:

Check overall accuracy and appearance.

JOB: Make a Change Elbow

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

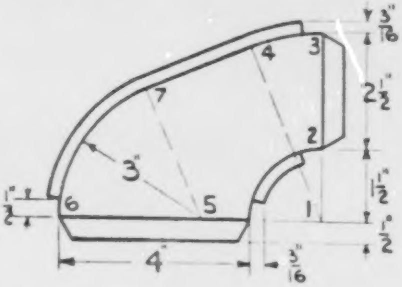
Practice safe work habits.

JOB SHEET
IDENTIFICATION CODE

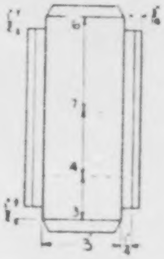
JOB NUMBER: J-5-35

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

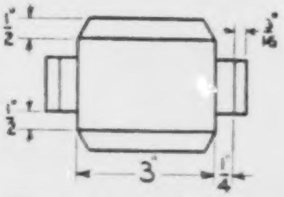
1. Select and lay out material.
2. Cut to size.
3. Shape duct.
4. Assemble as shown.



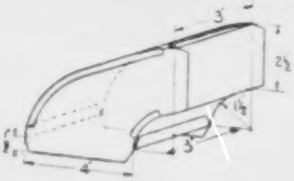
① LAYING OUT
CHEEK PATTERN



③ HEEL PATTERN



② THROAT PATTERN



④ PERSPECTIVE VIEW

METHOD OF EVALUATION:

Check overall accuracy and appearance.

JOB: Make a Transition Change Elbow

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

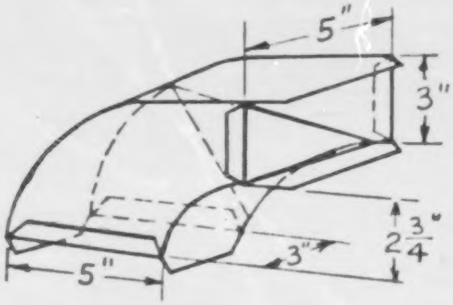
SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-36

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	
2. Cut to size.	
3. Shape duct.	
4. Assemble as shown.	



METHOD OF EVALUATION:

Check overall accuracy and appearance.

JOB: Fabricate a Two-in-One Elbow

UNIT V: Duct Fittings

COURSE: Sheet Metal

MATERIAL: 26 Gage Galvanized Iron

EQUIPMENT: Selected by Student

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-5-37

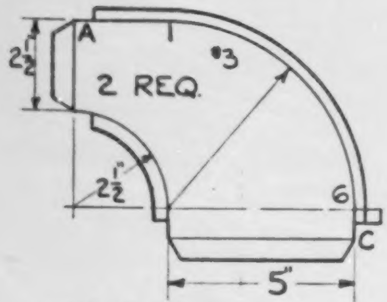
DRAWING NO: D-5-37

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select and lay out material.	
2. Cut to size.	
3. Shape duct.	
4. Assemble as shown.	

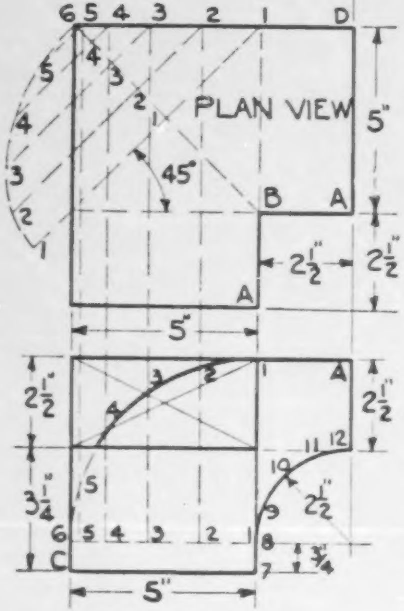
METHOD OF EVALUATION:

Check overall accuracy and appearance.

❹ CHEEK PATTERN

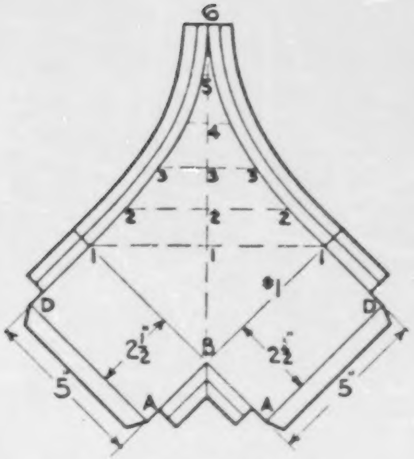


A
1
•3
2 REQ.
2½"
2½"
6
C
5"



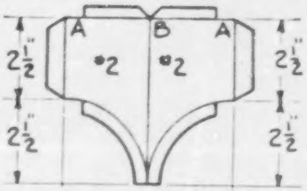
6 5 4 3 2 1 D
PLAN VIEW
5 4 3 2 1
45°
B A
5"
2½" 2½"
A
5"
3 2 1 A
4
2½" 2½"
11 12
10
5
3¼"
2½"
9
6 5 4 3 2 1 8
C
7
¾"
5"

❶ ELEVATION



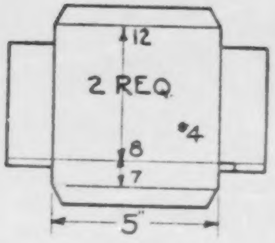
6
5
4
3 3 3
2 2 2
1 1 1
•1
D D
2½" B 2½"
5" A A 5"

❷ TOP HEEL PATTERN



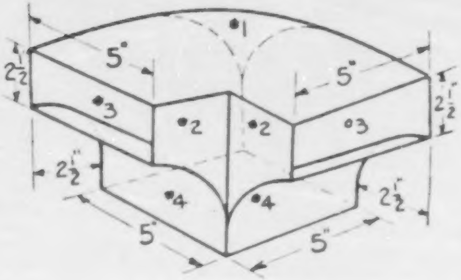
A B A
•2 •2
2½" 2½"
2½" 2½"

❸ CHEEK PATTERN



12
2 REQ.
•4
8
7
5"

❺ THROAT PATTERN



•1
5"
5"
2½"
2½"
•3
•2
•2
•3
2½"
2½"
•4
•4
5"
5"

❻ ISOMETRIC VIEW

TWO IN ONE ELBOW

DRAWING NUMBER
D-5-37

JOB: Cut a Hole in a Concrete Block

UNIT VI: Installation

COURSE: Sheet Metal

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-6-1

MATERIAL: Cement Block

EQUIPMENT: Safety Goggles

TOOLS: Star Chisel
Hammer

SAFETY PRECAUTIONS:

Protect your eyes.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out location for hole.	. SC-6-1
2. Select correct size star chisel.	
3. Strike chisel with hammer and turn chisel, repeat until hole is cut.	

METHOD OF EVALUATION:

Check for spalding around hole.
Check for accuracy of hole location.
Check for proper star chisel technique and procedure.

JOB: Install a Bracket

UNIT VI: Installation

COURSE: Sheet Metal

MATERIAL: Shelf Bracket

EQUIPMENT: Hammer Drill

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Protect your eyes.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-6-2

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out location for holes.	. SC-6-2
2. Select correct size masonary bit.	
3. Drill holes, (care should be taken to prevent bit from moving off the intended location).	
4. Install bracket to wall with nylon plugs and sheet metal screw.	

METHOD OF EVALUATION:

Check for alignment of holes in wall to bracket holes.
Check tightness of bracket to wall.
Check depth of hole to fit plug.
Check for proper installation procedure and technique.

JOB: Cut Kerf for Flashing

UNIT VI: Installation

COURSE: Sheet Metal

MATERIAL: Brick Wall

EQUIPMENT: Mortar Saw

TOOLS: Basic Hand Tools

SAFETY PRECAUTIONS:

Protect your eyes.

JOB SHEET IDENTIFICATION CODE

JOB NUMBER: J-6-3

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out location for kerf.	. SC-6-3
2. Saw kerf with masonary saw, (care should be taken to prevent the saw from moving off intended mark).	

METHOD OF EVALUATION:

Check for proper circular saw procedures and techniques.
The kerf should be uniform in depth and width.

JOB: Install Flashing

UNIT VI: Installation

COURSE: Sheet Metal

MATERIAL: Roll Flashing Caulking
Brick Wall from J-6-3
Sheet Lead or Hardwood

TOOLS: Hand Tongs
Caulking Gun

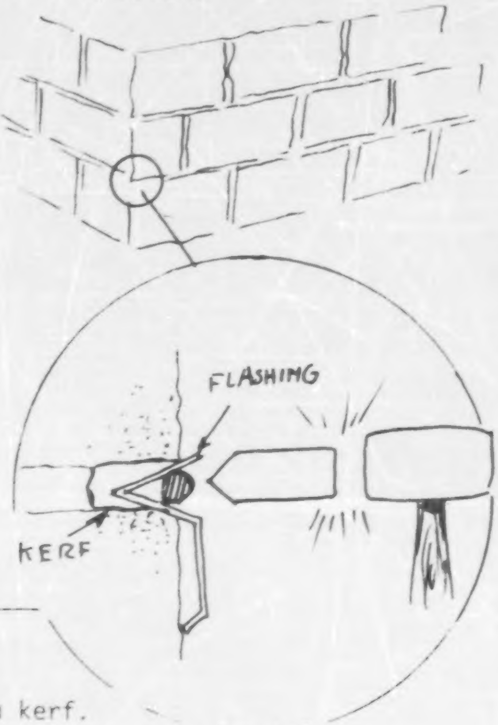
SAFETY PRECAUTIONS:

Practice safe work habits.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-6-4

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out flashing.	. SC-6-4
2. Cut to size.	. SC-6-5
3. Bend to shape.	
4. Place in kerf and secure with lead or hardwood wedges.	
5. Caulk flashing kerf. Seal joint, too.	



METHOD OF EVALUATION:

Check for proper tightness of flashing in kerf.
Check for proper flashing installation techniques and procedure.
Check for proper seal of joint.
Check for proper caulking technique and procedure.
Appearance of finished job.

JOB: Level a Furnace

UNIT VI: Installation

COURSE: Sheet Metal

MATERIAL: Furnace
Metal Shims

TOOLS: Level

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-6-5

SAFETY PRECAUTIONS:

Keep fingers clear of any area where they could be smashed or pinched.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Level length of furnace by raising the low end until level, then shim with metal shims to hold furnace in position.	. SC-6-6
2. Repeat to other side of furnace length.	
3. Repeat for both ends to level width.	
4. Recheck in all directions and shim if necessary.	

METHOD OF EVALUATION:

Check overall accuracy.
Check for leveling technique and procedure.

JOB: Rough-in A Register

UNIT VI: Installation

COURSE: Sheet Metal

TOOLS: Sawzall
Pinch Bar

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-6-6

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out hole to be cut.	. SC-6-7
2. Drill starting hole.	. SC-6-8A
3. Cut hole and remove any nails.	

METHOD OF EVALUATION:

Check proper sawzall technique and procedure.
Check for proper installation procedure.
Check for smoothness of cut.
Check accuracy of hole layout.

JOB: Install a Plenum

UNIT VI: Installation

COURSE: Sheet Metal

MATERIAL: Plenum

TOOLS: Screw Drill
Other Appropriate Tools

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-6-7

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Locate plenum on furnace.	. SC-6-6
2. Square and fasten to furnace with sheet metal screws.	. SC-6-8 . SC-6-9

METHOD OF EVALUATION:

Check for proper drill screw installation technique and procedure.
Check for proper plenum installation technique and procedure.
Check overall squareness and trueness of plenum to furnace.
Check for airtightness of plenum to furnace.

JOB: Install a Trunk Line

UNIT VI: Installation

COURSE: Sheet Metal

MATERIAL: Duct

TOOLS: Basic Hand Tools

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-6-8

SAFETY PRECAUTIONS:

Practice safe work habits.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Select the direction trunk line will travel.	. SC-6-6
2. Chalk a reference line.	. SC-6-8 thru SC-6-10
3. Install hangers.	
4. Using "S" and "drives" connect trunk line duct sections together and fasten to hangers.	
5. Check trunk line for level and adjust hangers if necessary.	

METHOD OF EVALUATION:

Check for proper trunk line installation.
Techniques and procedures.
Check overall accuracy and appearance.

JOB: Install a Branch Line

UNIT VI: Installation

COURSE: Sheet Metal

MATERIAL: Duct

TOOLS: Basic Hand Tools

SAFETYPPRECAUTIONS:

Practice safe work habits.

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-6-9

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Install the branch take off.	. SC-6-9
2. Assemble and install branch line duct and connect to boot.	
3. Install hangers as required.	

METHOD OF EVALUATION:

Check proper branch line installation.
Techniques and procedures.
Check overall accuracy and appearance.

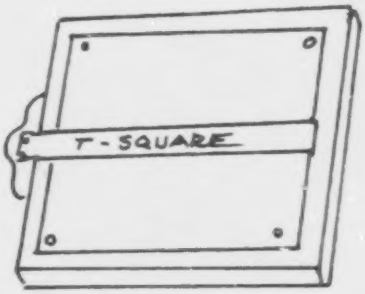
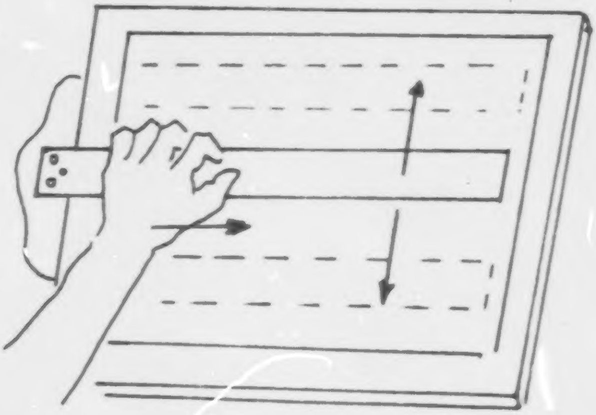
OPERATION SHEET
SC-2-1

COMPETENCY: Position and Move a T-Square

COURSE: Sheet Metal **UNIT II:** Drafting

OBJECTIVE: The student will be able to properly place and move a T-square

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place T-square on the drawing board.  	NOTE: The T portion will lockover the left side of the board.
2. Place left hand on the leg of the T-square and pull slightly to the right.	
3. Slide T-square up and down the board with the left hand while pulling to the right. 	NOTE: This will cause the T-square to be square with the edges of the board at all times.

OPERATION SHEET
SC-2-2

COMPETENCY: Place Paper on Drawing Board

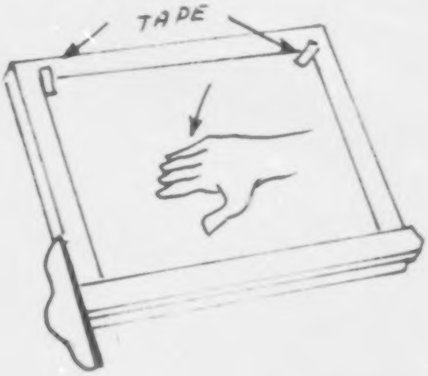
COURSE: Sheet Metal

UNIT II: Drafting

OBJECTIVE: The student will be able to efficiently and properly place the paper on the drawing board

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place drawing paper near center of drawing board and parallel to edges of board.	
2. Tape either upper left or upper right corner of paper to the drawing board.	
3. Place your hand on taped corner and slide any wrinkles to opposite side and tape.	
4. Place hand in middle of paper and slide all wrinkles to either of the two remaining corners.	
5. Complete last corner the same way.	NOTE: Paper should be free of wrinkles and nearly square to board.



OPERATION SHEET
SC-2-3

COMPETENCY: Place a Measurement on Paper

COURSE: Sheet Metal

UNIT II: Drafting

OBJECTIVE: The student will be able to mark a surface for layout of work lines

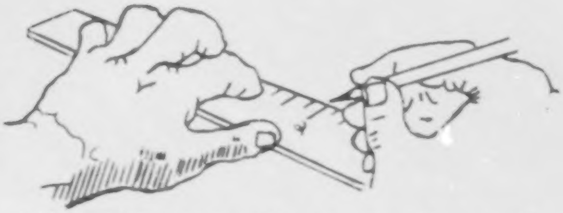
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

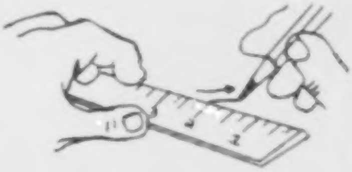
NOTE: This kind of marking requires accuracy, the marks are used in many trade areas.

1. Hold the ruler, tape, or scale firmly in place with the left hand.



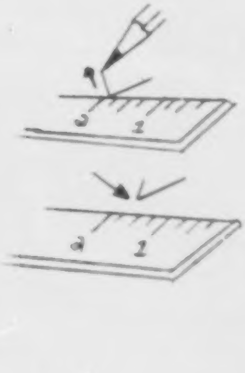
2. Place the point of the pencil or other marking device at the desired location on the surface to be marked.

3. Strike a small mark diagonally to the right.



4. Return the pencil to the original starting point and strike a line diagonally to the left.

NOTE: The resulting point on the V mark is the desired location.



OPERATION SHEET
SC-2-4

COMPETENCY: Use Triangles

COURSE: Sheet Metal

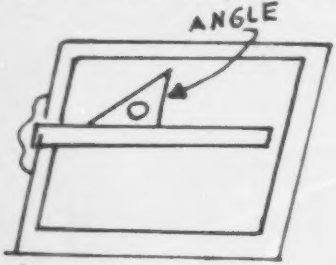
UNIT II: Drafting

OBJECTIVE: The student will be able to position angles so as to permit the drawing of various angled lines

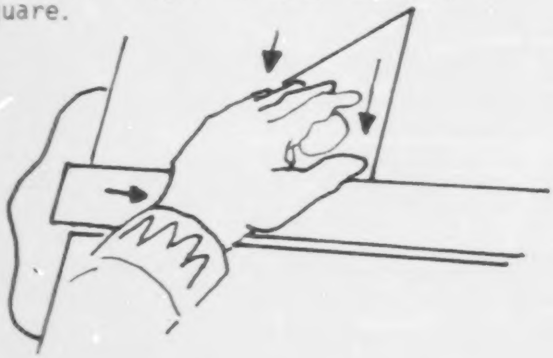
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

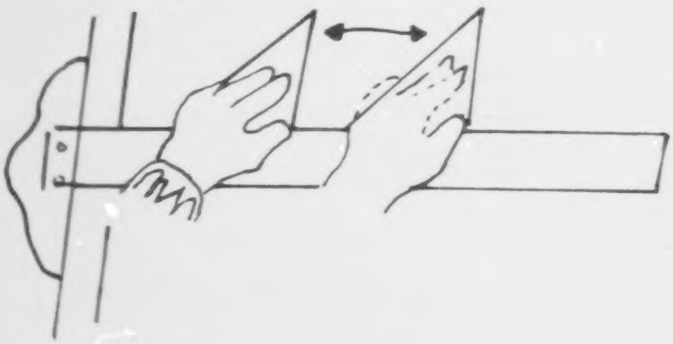
1. Place angle against top of T-square.



2. Hold angle against the T-square with the bottom edge of triangle in total contact with T-square.



3. Move the angle to the left and right taking care not to move T-square out of alignment with board.



OPERATION SHEET
SC-2-5

COMPETENCY: Use a Drafting Compass

COURSE: Sheet Metal

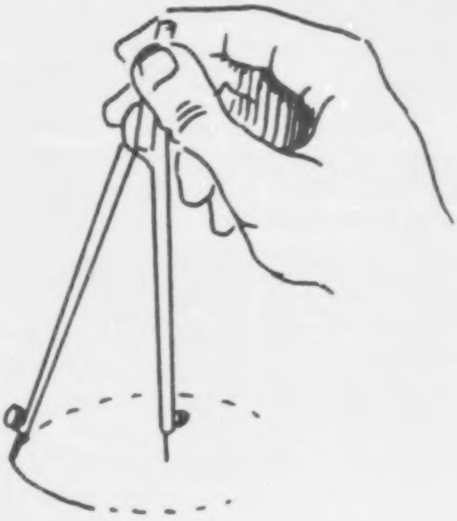
UNIT II: Drafting

OBJECTIVE: The student will be able to accurately scribe arcs

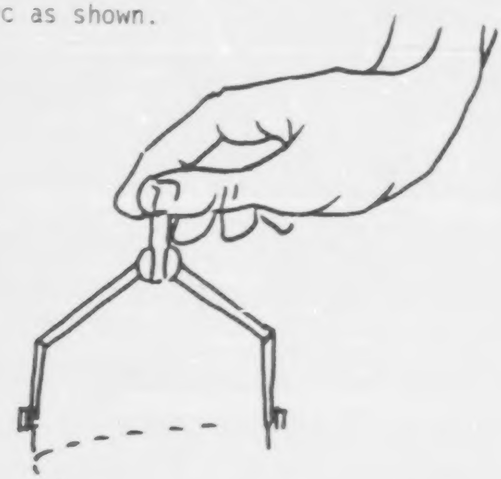
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Hold compass as shown.



2. Place the pin end on paper and press lightly.
3. Scribe arc as shown.



OPERATION SHEET
SC-2-6

COMPETENCY: Use Drafting Dividers

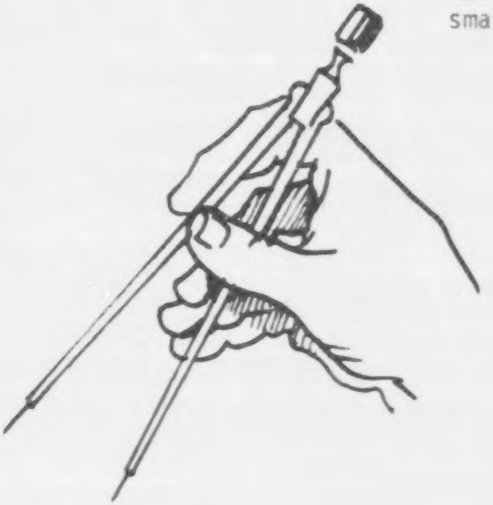
COURSE: Sheet Metal

UNIT II: Drafting

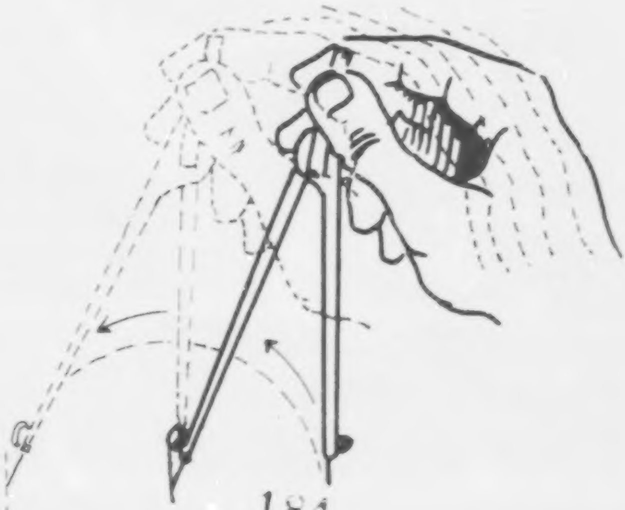
OBJECTIVE: The student will be able to transfer measurements and step off lines accurately and efficiently

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold dividers in	NOTE: Keep divider marks small to accomodate accuracy.



2. Set dividers to required size.	
3. Place dividers on drawing and step off desired lengths by holding dividers as shown.	NOTE: When adjusting be sure one point of divider is free to move.



OPERATION SHEET
SC-2-7

COMPETENCY: Use a Scaling Rule

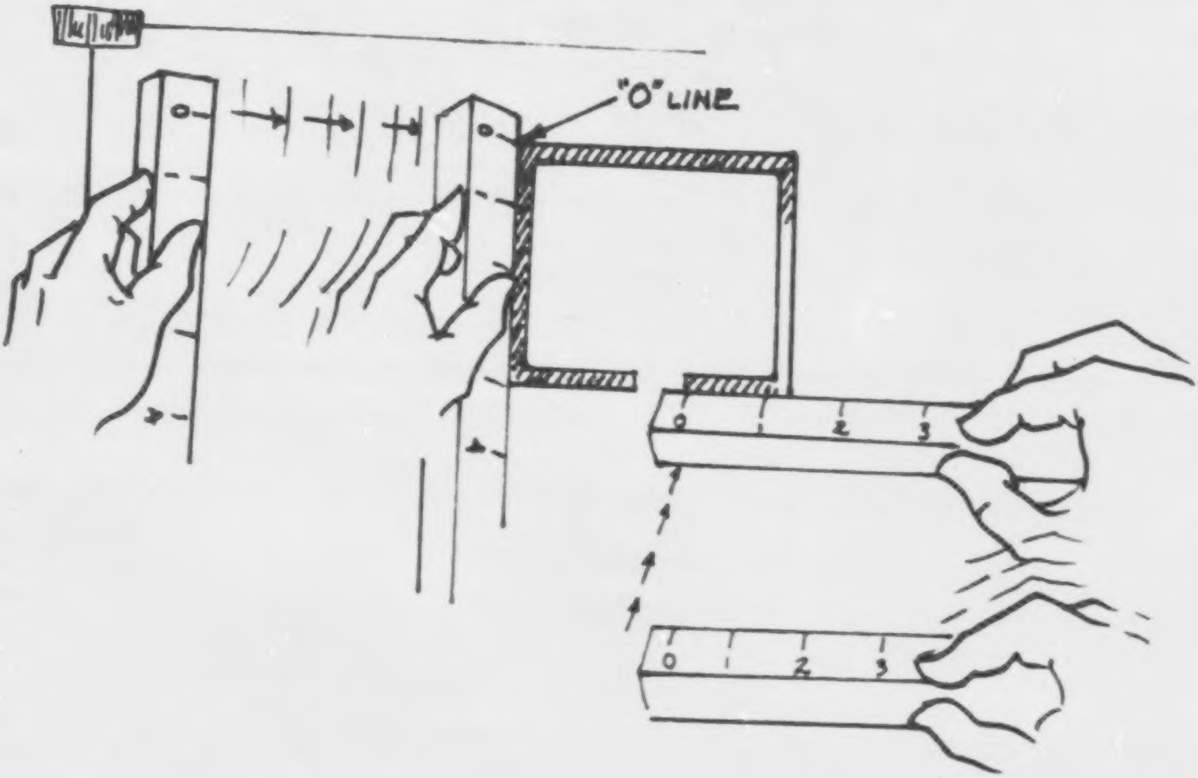
COURSE: Sheet Metal

UNIT II: Drafting

OBJECTIVE: The student will be able to properly position the scale for correct and accurate measurements

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Slide scale onto paper with left hand (vertically or horizontally).	
2. Align zero "0" line with the spot or edge of space to be measured.	



OPERATION SHEET
SC-2-8

COMPETENCY: Use a Protractor

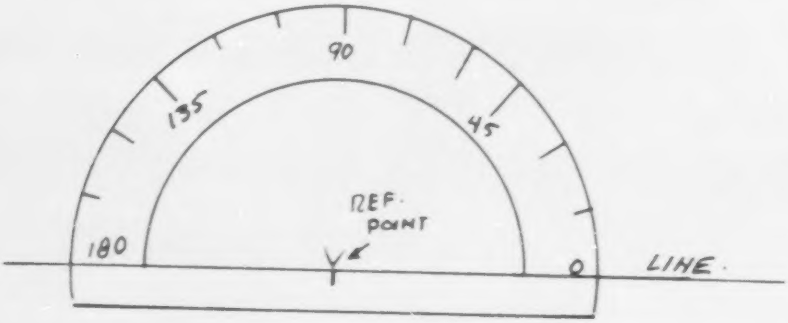
COURSE: Sheet Metal

UNIT II: Drafting

OBJECTIVE: The student will be able to lay out angles accurately

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place a protractor on the line as shown being careful that reference points are correctly aligned.	



2. Mark deisred angle.

OPERATION SHEET
SC-3-1

COMPETENCY: Measure Sheet Metal with Metal Gage

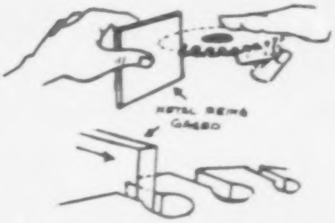
COURSE: Sheet Metal

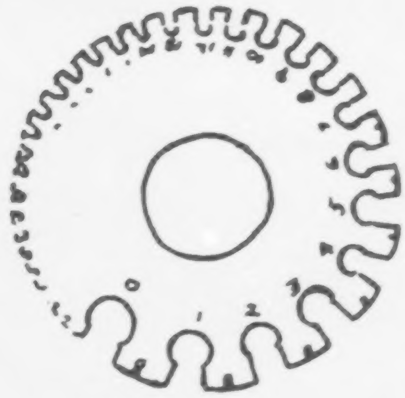
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to accurately gage metal with a metal gage

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the gage in right hand and the metal to be gaged in left hand.	
2. Slide the parallel sides of the slots in the gage over the edge of the sheet.	NOTE: The slot that makes a snug fit tells the gage of the metal.





OPERATION SHEET
SC-3-2

COMPETENCY: Measure Using a Micrometer

COURSE: Sheet Metal

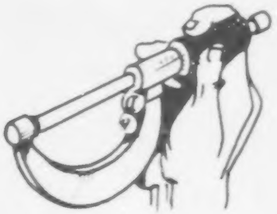
UNIT II: Hand Tools and Machines

OBJECTIVE: The student will be able to accurately take measurements using a micrometer

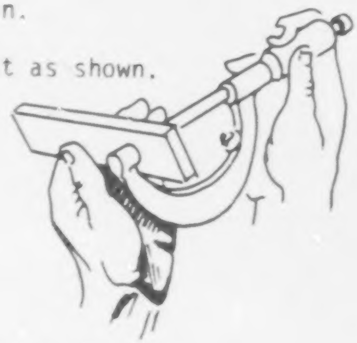
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Hold the micrometer as shown.



2. Close to check calibration.
3. Open and place over object as shown.



4. Close until a slight firmness is felt.
5. Read the measurement.
6. Open and remove micrometer.

OPERATION SHEET
SC-3-3

COMPETENCY: Mark with a Pencil, Soap Stone Chalk or Scribe

COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

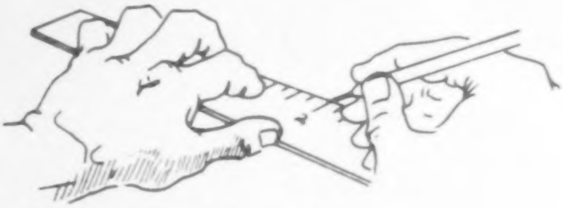
OBJECTIVE: The student will be able to mark a surface for layout of lines used in work

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

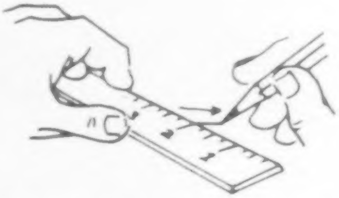
NOTE: This kind of marking requires accuracy, the marks are used in many trade areas.

1. Hold the ruler, tape, or scale firmly in place with the left hand.



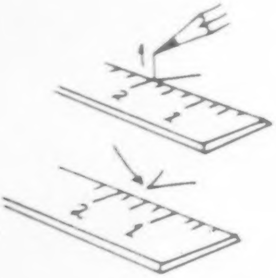
2. Place the point of the pencil or other marking device at the desired location on the surface to be marked.

3. Strike a small mark diagonally to the right.



4. Return the pencil to the original starting point and strike a line diagonally to the left.

NOTE: The resulting point on the V mark is the desired location.



OPERATION SHEET
SC-3-4

COMPETENCY: Mark Metal with a Prick or Center Punch

COURSE: Sheet Metal

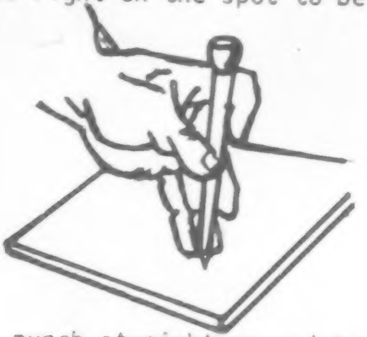
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to efficiently use the prick or center punch

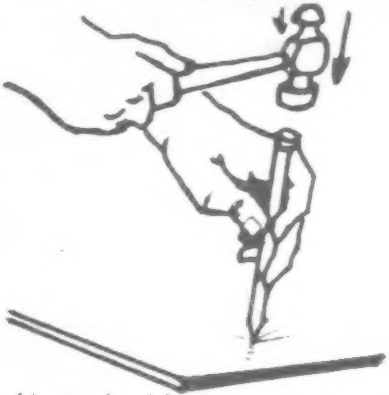
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Hold the punch in one hand and place the point right on the spot to be marked.



2. Hold the punch straight up and tap the top of it lightly with a hammer.



3. Tap it again if the mark is not deep enough.

OPERATION SHEET
SC-3-5

COMPETENCY: Scribe a Line with a Scratch Awl and a Straight Edge

COURSE: Sheet Metal

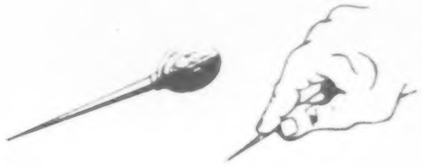
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to develop accuracy of scribing to a rule or straight edge

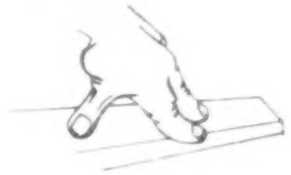
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

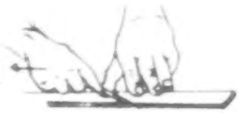
1. Place the straight edge or steel rule on the work in the position to be scribed.
2. Hold the scratch awl in hand with index finger stretched out.



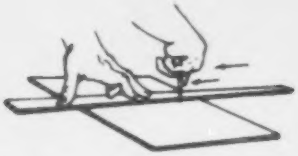
3. With the other hand press firmly on the straight edge or rule.



4. Tip the handle of the awl out a little and set the point of the awl as close to the edge of the straight edge as possible.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
5. Scribe a line by pushing down on the awl and drawing it along the edge of the straight edge.	NOTE: The handle should be tilted slightly in the direction the awl is to be moved.



OPERATION SHEET
SC-3-6

COMPETENCY: Make a Straight Cut With Straight, Combination or Bulldog Snips

COURSE: Sheet Metal

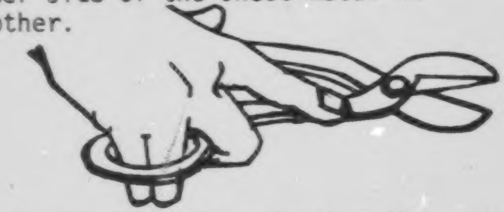
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to become familiar with using the hand snips

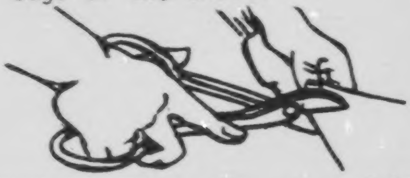
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Grasp the snips with one hand and the shorter side of the sheet metal in the other.

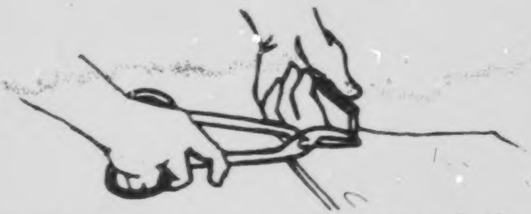


2. Open the blades wide and start the cut at the edge of the sheet.



3. Hold the blades of the snips at a right angle to the sheet and cut.

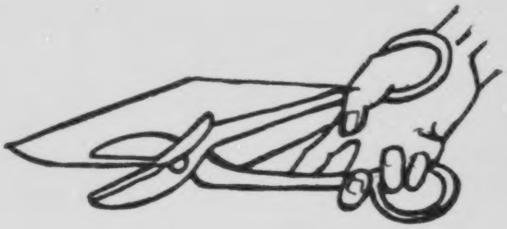
NOTE: Keep from getting jagged edges by closing the blades just short of the full length.



4. Start the next cut at the end of the one before.

5. Finish the cut.

NOTE: Keep the snips on the line by changing the angle of the cut if necessary.



OPERATION SHEET
SC-3-6A

COMPETENCY: Cut an Inside Square with Aviation Shears

COURSE: Sheet Metal

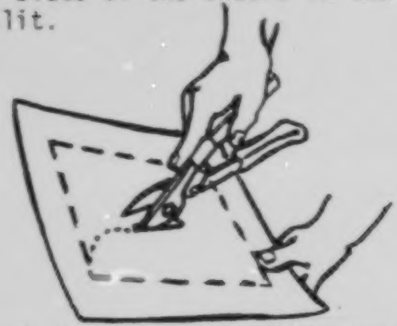
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly cut an inside square using the aviation shears

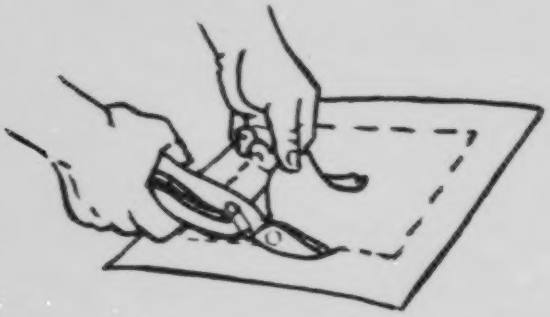
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

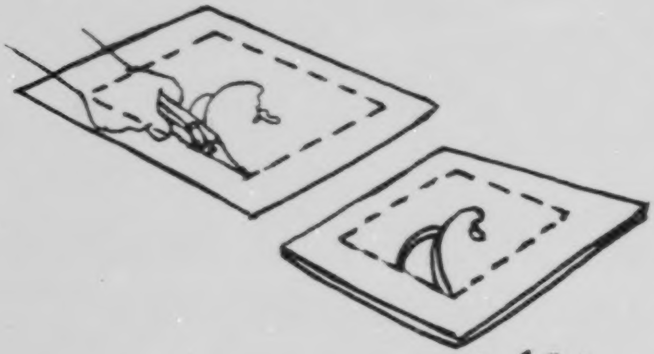
1. Insert the blade of the shears in the starting slit.



2. Cut a spiral in the center of the square.



3. Swing an arc to one of the scribed lines and cut to the right hand corner and stop.



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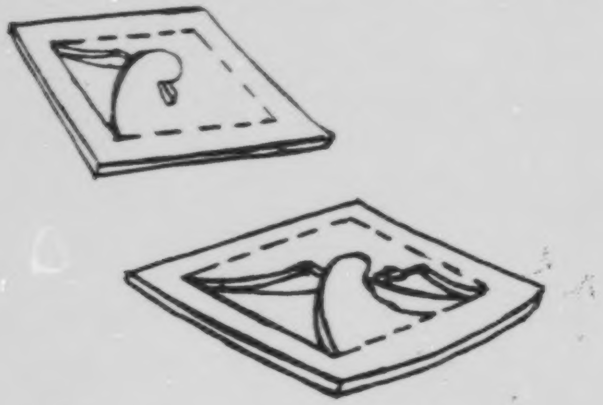
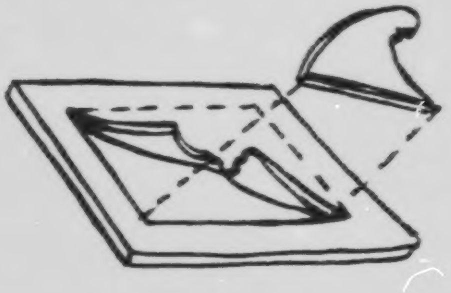
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

4. Swing an arc to the next side, to the right. Cut to the same corner and stop.



5. Cut the rest of each of the partly cut sides to the corners and stop.



6. Repeat Steps 4, 5, and 6 to finish cutting the square.

OPERATION SHEET
SC-3-6B

COMPETENCY: Make an Inside Curved Cut with Hand Shears

COURSE: Sheet Metal

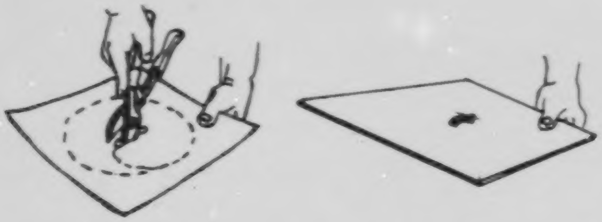
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to become familiar by hands-on experience with the most effective way to cut inside curves

Page 1 of 1 page

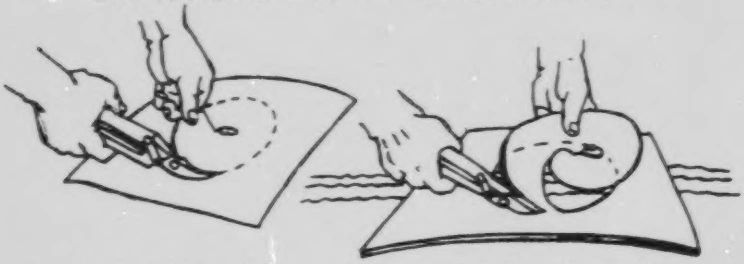
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Insert one blade of the shears in the starting slit.



2. Start the cut by squeezing the shears and then relax hand and they will open automatically.

3. Keep the blades of the shears vertical and cut an arc to the scribed circle.



4. Work the shears with one hand and at the same time turn the metal with the other hand. Cut until the circle is complete.

OPERATION SHEET
SC-3-6C

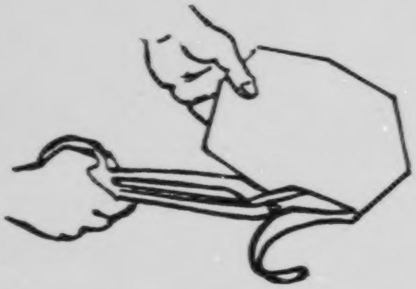
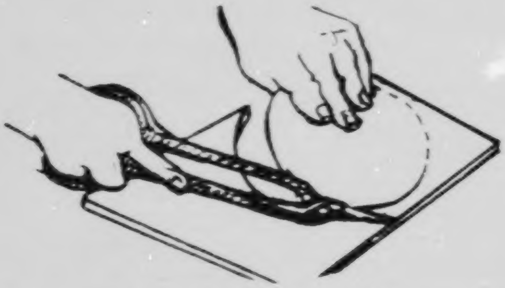
COMPETENCY: Cut Outside Curved Cuts With Combination Shears

COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to manipulate the combination shears so that cuts are neat and free of burrs

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the metal in one hand and the shears in the other. 	
2. Start the cut by squeezing the handle of the shears. 	NOTE: Open the shears by hand after the cut is made.
3. While working the shears with one hand, keep turning the metal with the other hand.	NOTE: Keep the blades of the shears straight up and down while you are cutting.

OPERATION SHEET
SC-3-6D

COMPETENCY: Cut Wire with Side Cutters or Diagonals

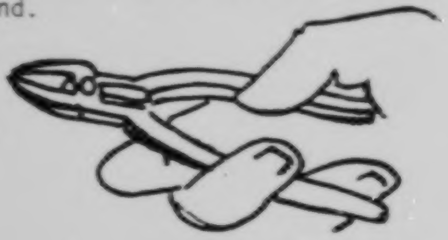
COURSE: Sheet Metal

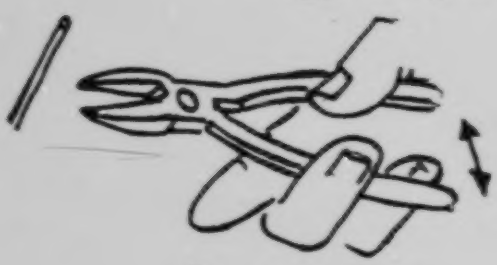
UNIT III: Hand Tools and Machines

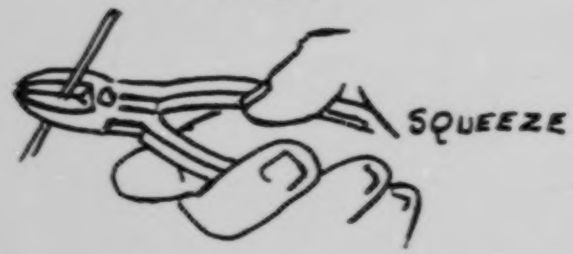
OBJECTIVE: The student will be able to cut the wire to the proper length acceptable to shop standards per-set by the instructor

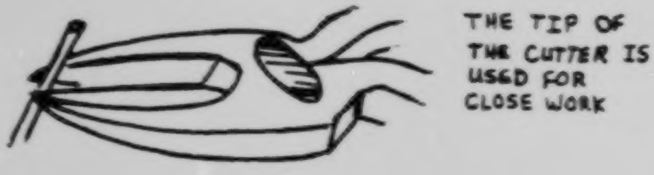
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the side cutters in your right hand.	








THE TIP OF
THE CUTTER IS
USED FOR
CLOSE WORK

OPERATION SHEET
SC-3-6E

COMPETENCY: Notch Metal

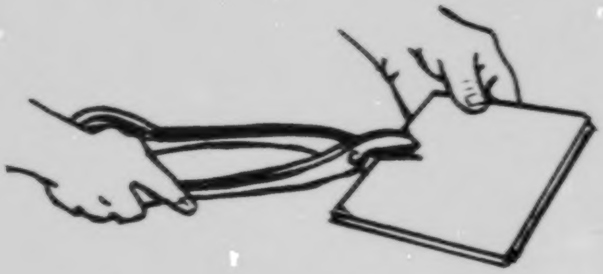
COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

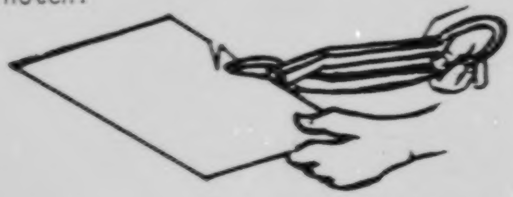
OBJECTIVE: The student will be able to cut notches without cutting too deeply or leaving ragged edges

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the snips in one hand and the job in the other.	NOTE: You might have to rest the snips and the job on the bench.
2. Open the blades of the snips and place them on one side of the notch to be cut.	CAUTION: Make sure the piece being cut does not fly toward another worker. NOTE: Make sure that the end of the blade does not go over the end of the notch.

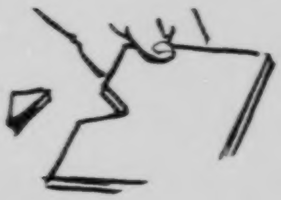


3. Squeeze the blades closed making sure you do not cut past the end of the notch.



4. Cut the opposite side of the notch.

NOTE: Do not cut past the end of the notch.



OPERATION SHEET
SC-3-7

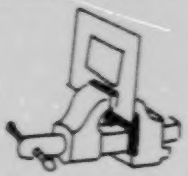
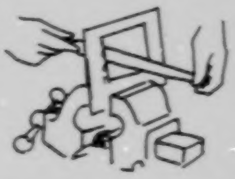
COMPETENCY: Smooth and Shape Metal Using a File

COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to smooth metal and to remove excess metal smoothly

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Firmly secure metal in a machinist vise. 	
2. Hold the handle of the file in one hand with index finger stretched out on top the file and the point of the file with the thumb and first two fingers of the other hand. 	
3. File with forward strokes diagonally across the edge.	
4. Lift the file and move it back to make the next stroke.	NOTE: Don't drag the file back across the metal.

OPERATION SHEET
SC-3-8

COMPETENCY: Lay Out a Square Line on Stock

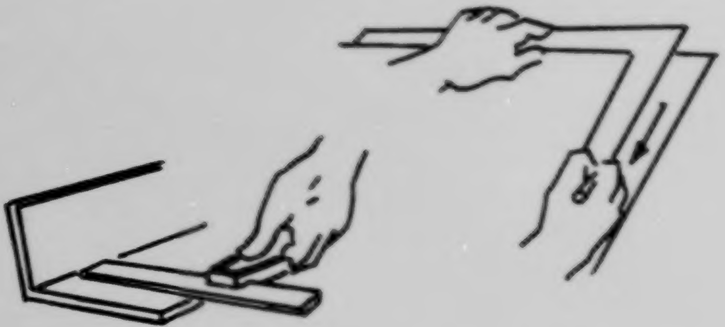
COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

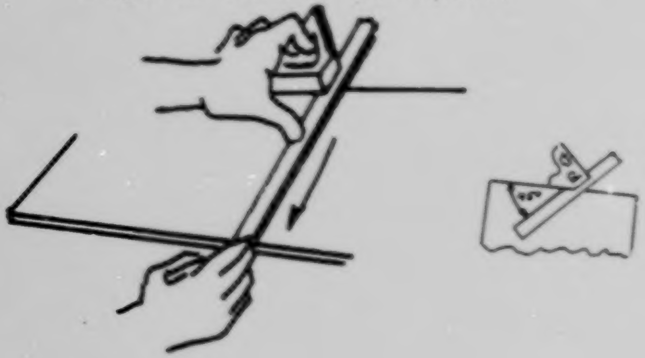
OBJECTIVE: The student will be able to accurately and neatly lay out a square line on stock

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place the body or head of the square along or against the finished edge of the stock.	NOTE: Make sure the blade or tongue of the square touches both places as shown.



2. Mark along the outside edge of the tongue or blade of the square.



OPERATION SHEET
SC-3-9

COMPETENCY: Shear Metal on Squaring Shear Using Side and Back Gage

COURSE: Sheet Metal

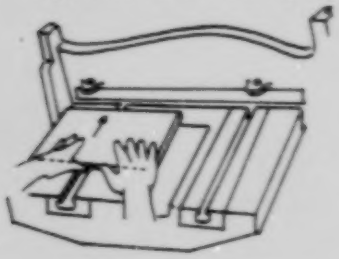
UNIT III: Hand Tools and Machines

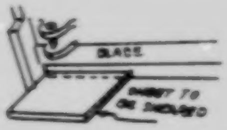
OBJECTIVE: The student will be able to safely and efficiently shear metal using side and back gage

Page 1 of 1 page

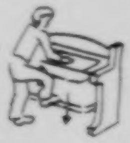
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

1. Lay the larger part of the sheet on the bed with the edge to be cut square against the back gage and side gage.





2. Keep both hands on the sheet metal and then step on the foot treadle until the hold-down grips. Continue downward pressure until metal is cut.



3. Slowly raise foot treadle until upper blade returns to original position.

TEACHING/LEARNING ACTIVITIES

NOTE: Check side gage for squareness to blade and proper scale reading.

NOTE: If you can, keep the sheet at the left hand side of the shear so it won't move when it is being cut.

OPERATION SHEET
SC-3-9A

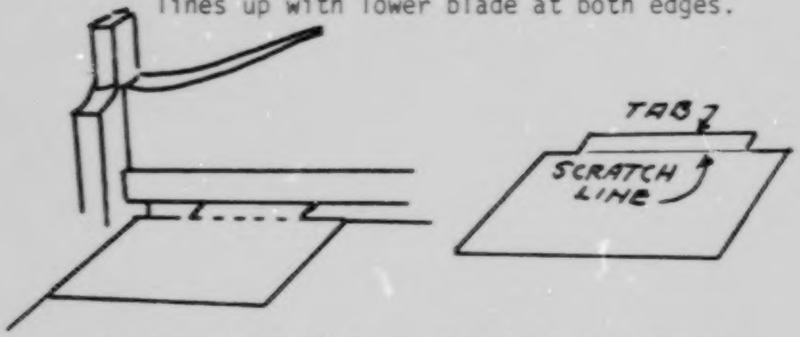
COMPETENCY: Shear to Reference on Squaring Shear without Gages

COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to accurately shear metal to a particular reference on squaring shear without gages

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place the sheet to be cut on the bed with the largest part of the sheet towards the operator.	NOTE: If you can, keep the sheet at the left hand side of the shear so it won't move when it is being cut.
2. Push the part of the sheet to be cut through the blades.	
3. Pull back against the lower blade until tabs are aligned or until scratch line lines up with lower blade at both edges.	
 	
4. Keep both hands on the sheet and step on foot treadle until hold-down grips the metal firmly.	
5. Continue with downward pressure on foot treadle until cut is completed.	
6. Slowly raise foot treadle until upper blade returns to original position.	

OPERATION SHEET
SC-3-10

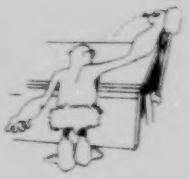
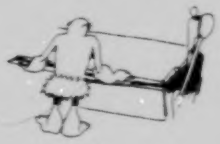
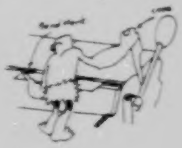
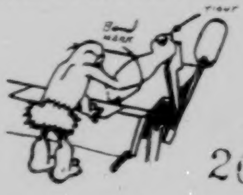
COMPETENCY: Bend Metal on the Cornice Brake

COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

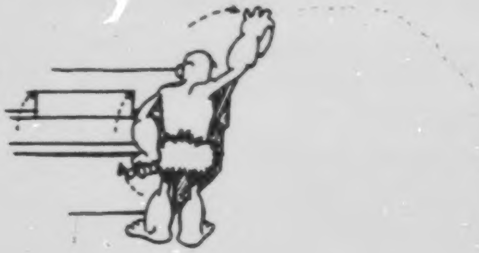
OBJECTIVE: The student will be able to accurately aline the brake to bend lines and learn to make bends to the proper degree

Page 1 of 2 pages

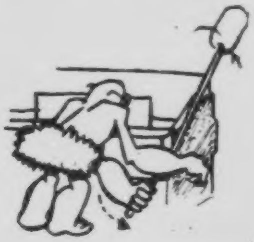
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Open the right clamping bar by pushing back the clamping bar handle. 	NOTE: On a long sheet, open both clamping bars.
2. Place the sheet between the upper and lower jaws of the machine from the front. 	
3. Line up the left hand bend mark on the sheet under the edge of the upper jaw and pull the right clamping bar to firmly hold the left side of the sheet. 	
4. Adjust the right hand bend mark with the edge of the upper jaw and pull the clamping bar to tighten the sheet completely. 	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES

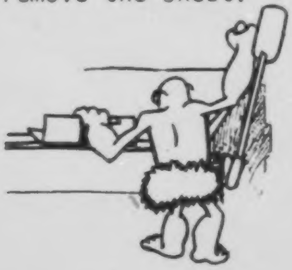
5. With right and left hands positioned as shown, raise the bending leaf to make the desired bend.



6. Keeping hand on the bending leaf handle, lower it slowly to its beginning position.



7. Open the brake jaws with the clamping handle and remove the sheet.



OPERATION SHEET
SC-3-11

COMPETENCY: Form an Outside Grooved Seam

COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to form an outside groove seam with the hand groover

Page 1 of 2 pages

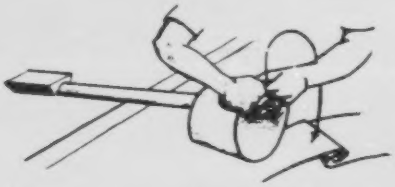
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

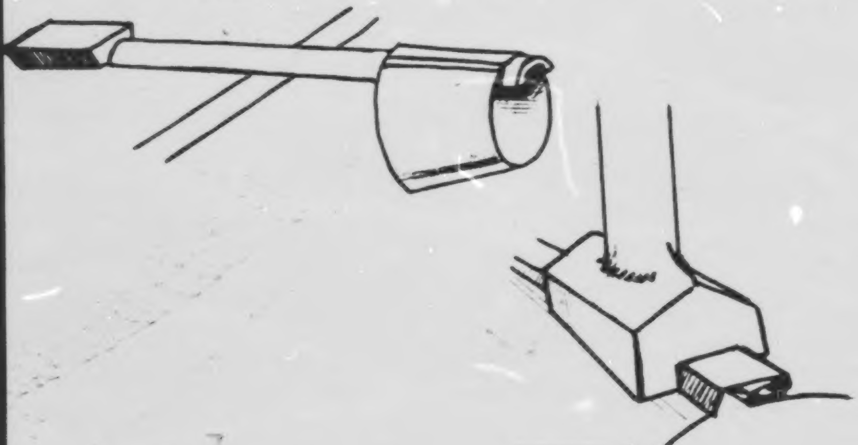
1. Place the job on a suitable bucking surface.

2. Hook the edges of the metal sheet together.

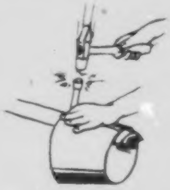
NOTE: Make sure the bottom and top edges meet smoothly.



3. Turn the work so the seam is in the center of the bucking surface and put the hand groover over one end of the seam.

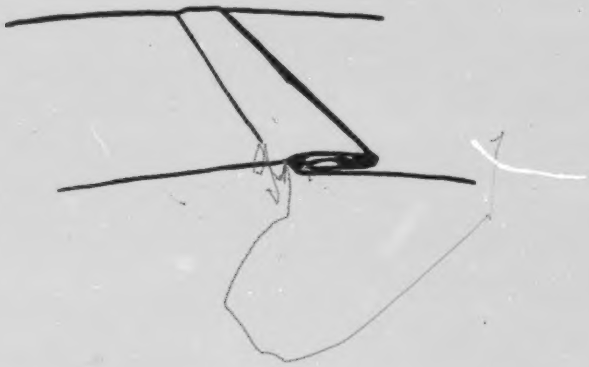


4. Strike the groover with a riveting hammer until a groove is made.



5. Make sure the seam at the other end is locked together and repeat steps 3 and 4.

6. Groove the rest of the seam the same way moving the groover about half its length at a time.



OPERATION SHEET
SC-3-12

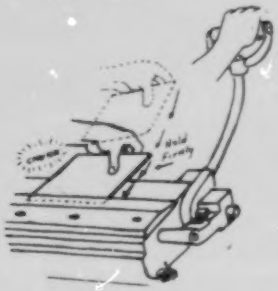
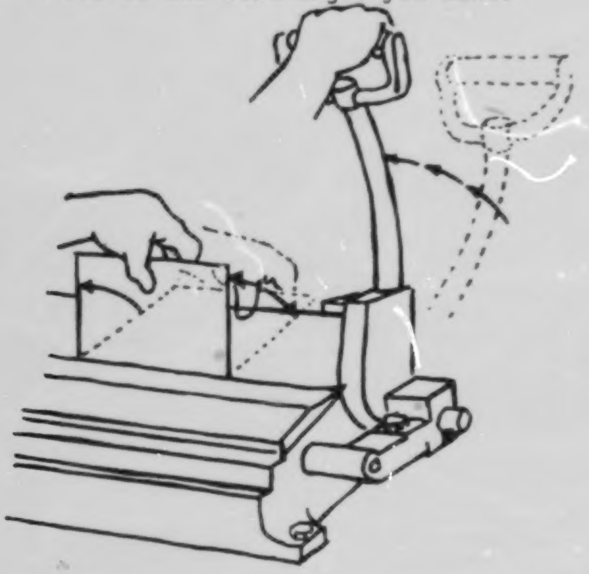
COMPETENCY: Form Metal on the Bar Folder

COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

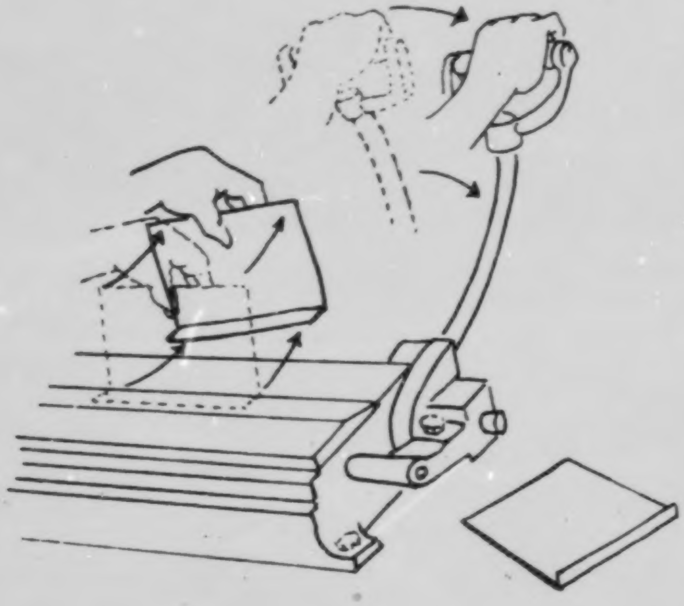
OBJECTIVE: The student will be able to develop the proper and most efficient ways to use the bar folder

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Put the edge of the metal to be bent between the jaws of the bar folder.	NOTE: Make sure the edge is tight against the fingers of the bender.
2. Hold the metal firmly against the gage fingers with left hand.  	
3. With right hand, pull the operating handle to the bend angle you want. 	

4. Without releasing your right hand, slowly return the operating handle to its original position.

5. Remove the metal from the folder.



OPERATION SHEET
SC-3-13

COMPETENCY: Scribe Arcs with Dividers or Compass

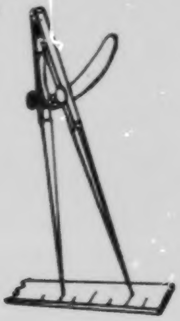
COURSE: Sheet Metal

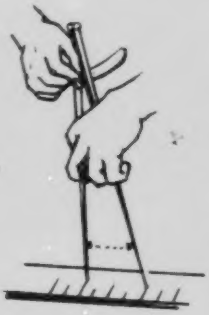
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to accurately scribe arcs with dividers or compass

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set the dividers by holding them in one hand and placing the point of one leg on the 1" mark of the rule and then adjust the other leg of the dividers until it rests on the mark equal to the radius you need plus 1".	
2. Hold the dividers between the fingers and the thumb.	
3. Place the point of one leg on the center mark.	NOTE: Press on it hard enough to hold the point in place.





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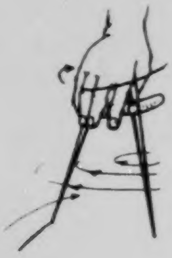
COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
4. Swing the other leg of the dividers clockwise, and push down on it to scribe an arc or circle.	



OPERATION SHEET
SC-3-14

COMPETENCY: Tin a Soldering Copper

COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly tin a soldering copper for use

Page 1 of 2 pages

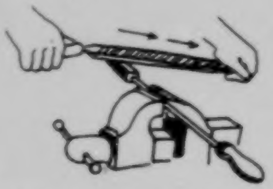
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. See that handles on the soldering coppers are secure.

2. Place the soldering copper to be tinned in the gas furnace until it is heated to a cherry red.

3. Remove the soldering copper from the furnace and clamp it in a vise.

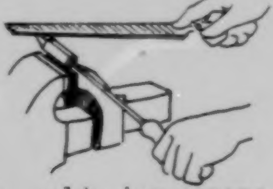
4. File the pointed sides of the soldering copper until they are bright and smooth on all four sides.



5. File off the sharp point of the soldering copper.

6. Remove the soldering copper from the vise.

7. Place the soldering copper in the opening of the vise and file off the sharp edge.

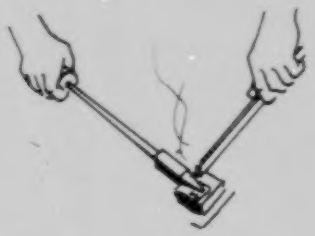


8. Replace the soldering copper in the furnace and reheat it to a degree that will just melt the solder.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES

9. Remove the soldering copper from the furnace and rub each filed side back and forth across a cake of sal ammoniac, cleaning the four sides.

10. Add a little solder to the soldering copper while rubbing each side back and forth across the sal ammoniac until the copper is tinned.



11. The soldering copper is now ready for use.

OPERATION SHEET
SC-3-14A

COMPETENCY: Solder a Seam With a Soldering Iron

COURSE: Sheet Metal

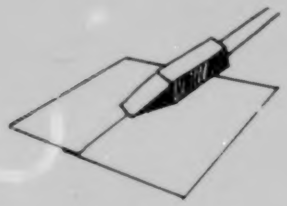
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to learn the correct methods used when soldering with a soldering iron

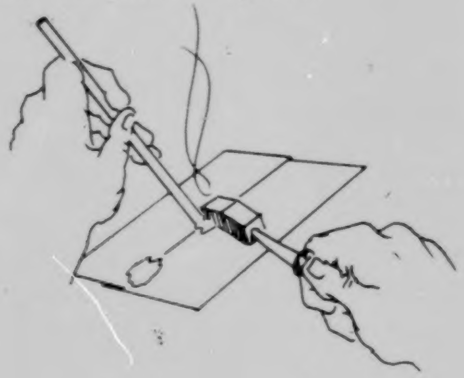
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Put the job in position on a support.

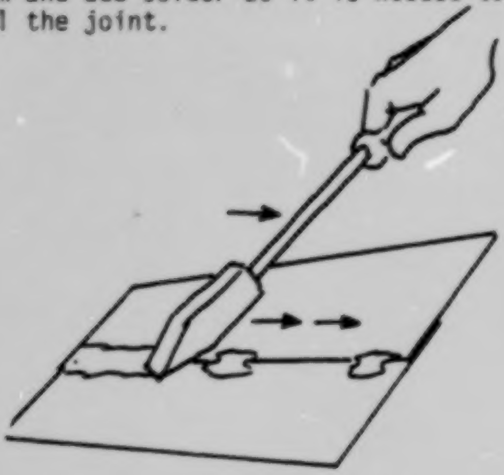


2. Apply the soldering flux, to the area to be soldered only, with an acid swab.
3. Grasp the heated soldering iron by the handle and clean the tinned surface by quickly dipping only the tinned tip into the dipping solution.
4. Hold the iron at one end of the seam until the solder flows easily into the joint to tack the joint in place.



5. *Tack the seam where necessary to hold the* joint in place.

6. Hold the soldering iron at one end of the seam. Draw the iron toward you along the seam and add solder as it is needed to fill the joint.



OPERATION SHEET
SC-3-15

COMPETENCY: Punch Holes with Hand Punch

COURSE: Sheet Metal

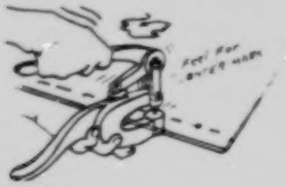
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to place punch in proper location, adjust dies and punch holes cleanly and with minimum manual effort

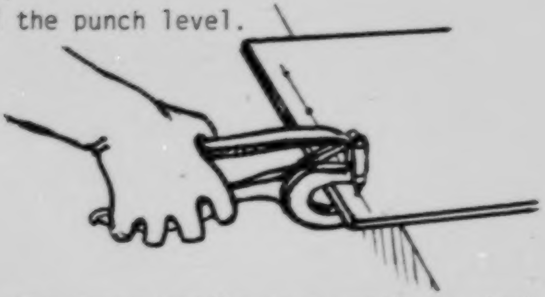
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

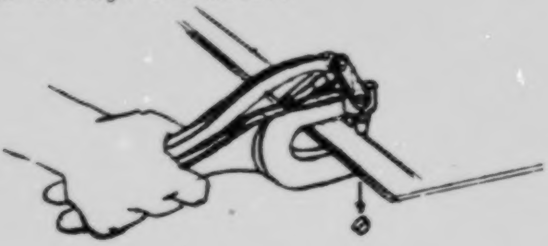
1. Mark the centers of the holes to be punched with a prick punch.
2. Lay the metal to be punched over the edge of the bench.
3. Center the punch point over one of the marks.



4. Hold the punch level.



5. Push the upper handle down until you feel it go through the metal.



OPERATION SHEET
SC-3-16

COMPETENCY: Rivet with a Rivet Set

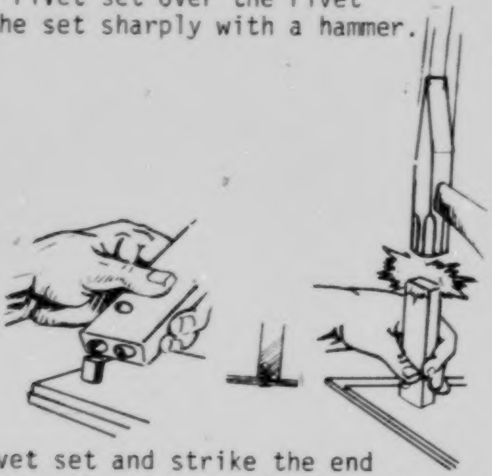
COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

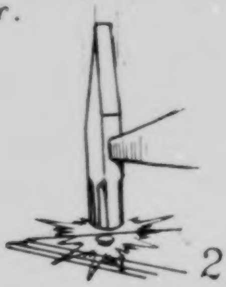
OBJECTIVE: The student will be able to gain workable knowledge of using a riveting set and hammer to upset rivets properly

Page 1 of 2 pages

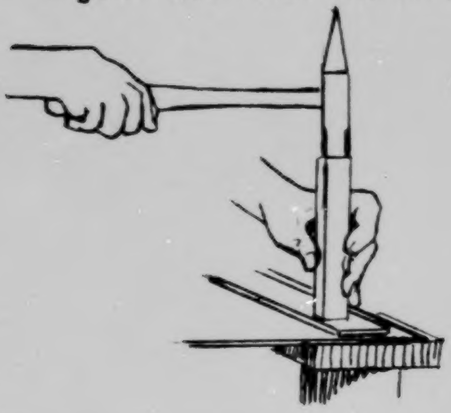
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Put the job to be riveted on a bucking surface.	
2. Put the rivet through the hole.	NOTE: On long jobs you might have to put the hole in the job over the rivet.
3. Hold the rivet in place with finger and center the head of the rivet against the bucking surface.	
4. Tighten the hole and the rivet head together by setting the hole in the bottom of the rivet set over the rivet and hitting the set sharply with a hammer.	

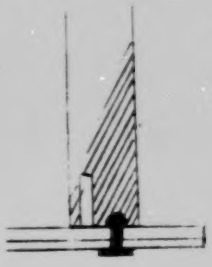


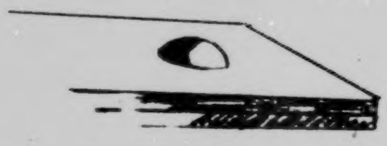
5. Remove the rivet set and strike the end of the rivet squarely with the face of the riveting hammer.



6. Put the cup-shaped hole in the bottom of the rivet set on the rivet and strike the rivet set with the riveting hammer until a good round rivet head is formed.







OPERATION SHEET
SC-3-16A

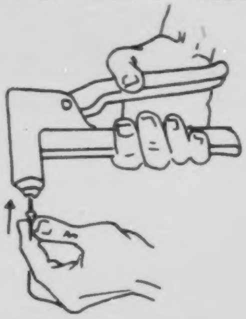
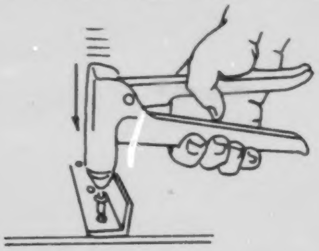
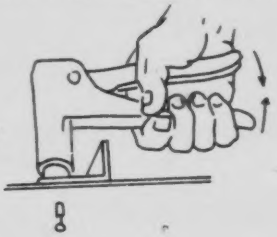
COMPETENCY: Rivet with a Pop Rivet Gun

COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly apply rivets with the pop rivet gun

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Open handle completely and insert rivet mandrel into nosepiece until rivet head is in contact with face of nosepiece. 	
2. Close handle lightly until contact is made between rivet mandrel and riveter jaw. At this point using riveter as a guide, insert rivet into hole of unit to be riveted. 	NOTE: Bottom face of rivet head and outer surface of unit to be riveted must be in contact at this time.
3. Squeeze movable handle down until rivet is set. 	

OPERATION SHEET
SC-3-17

COMPETENCY: Hold Materials with "C" Clamps

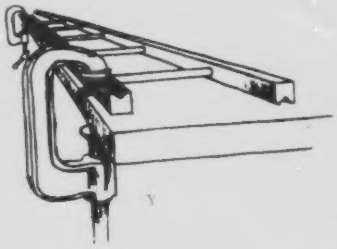
COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly secure material with "C" clamps

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Open "C" clamp by turning the screw counter clockwise.	
2. Place "C" clamp over items to be held together.	
3. While holding clamp with one hand, turn screw clockwise to close the clamp.	
4. As clamp begins to become tight, twist the "t" handle to the desired holding force.	



OPERATION SHEET
SC-3-17A

COMPETENCY: Hold and Tighten with a Rib Lock Plier

COURSE: Sheet Metal

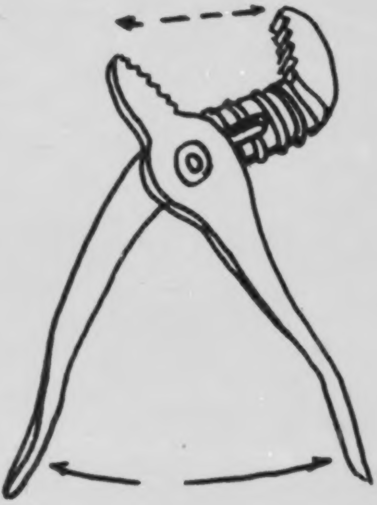
UNIT III: Hand Tools and Machines

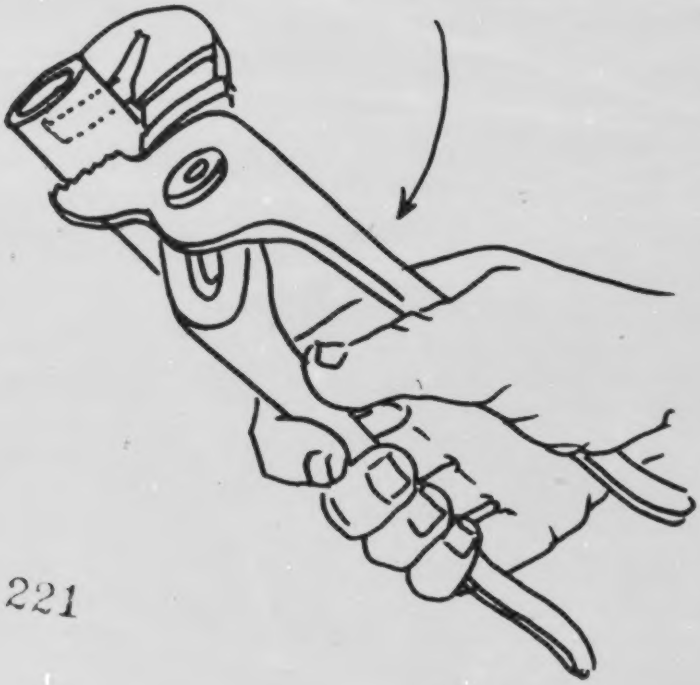
OBJECTIVE: The student will be able to use the rib lock pliers in a safe and efficient manner

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Open jaws fully; slide jaws to proper rib.
2. Close jaws and squeeze to hold item.
3. Maintain pressure while turning or holding.
4. Release pressure to move to a new location.





OPERATION SHEET
SC-3-18

COMPETENCY: Notch Metal on the Coper Notcher Shears

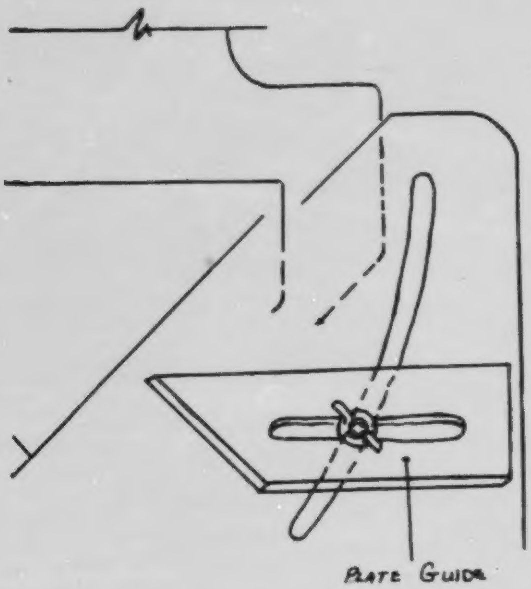
COURSE: Sheet Metal   **UNIT III:** Hand Tools and Machines

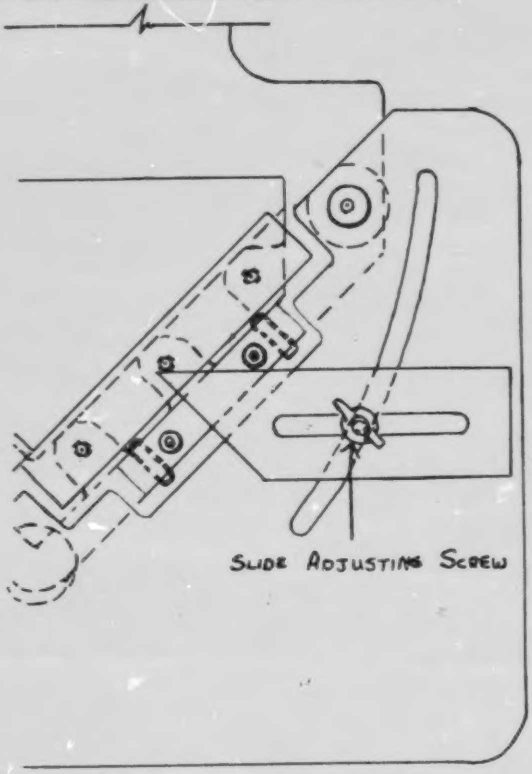
OBJECTIVE: The student will be able to properly operate the coper notcher shears

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

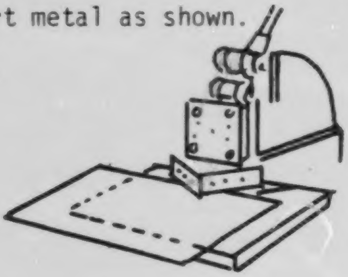
1. Loosen the two slide adjustment screws.





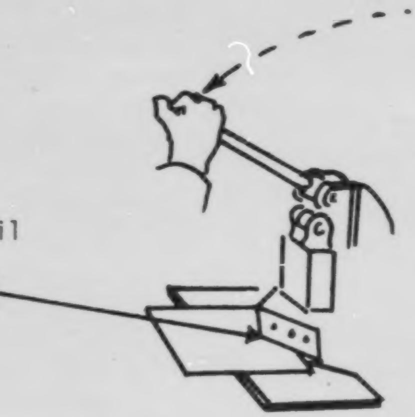
2. Align plate guides to desired cut.

3. Insert metal as shown.

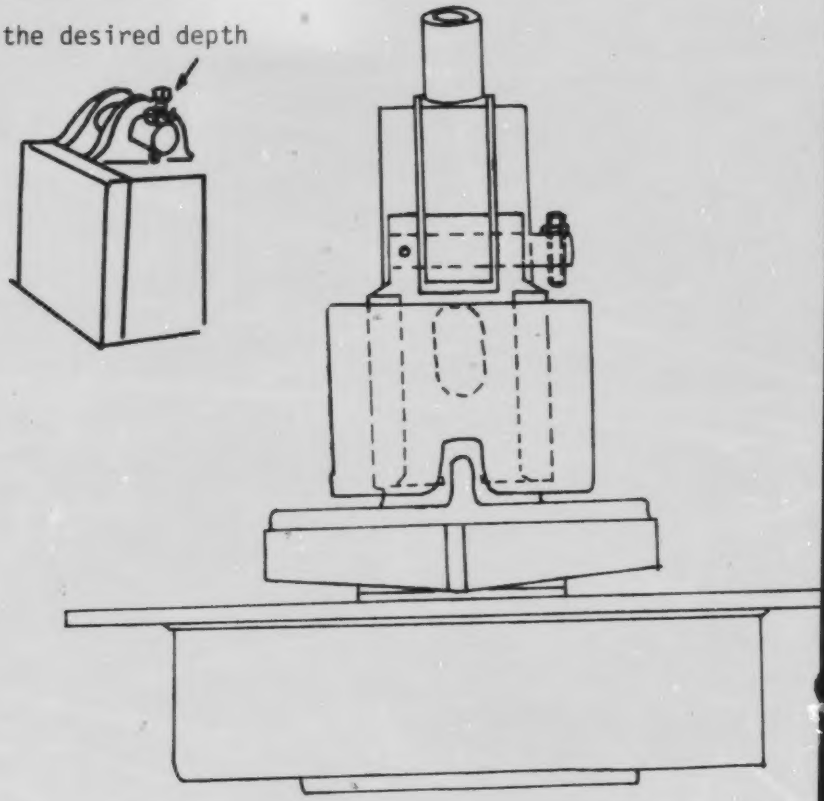


NOTE: Metal must be snug against guides.

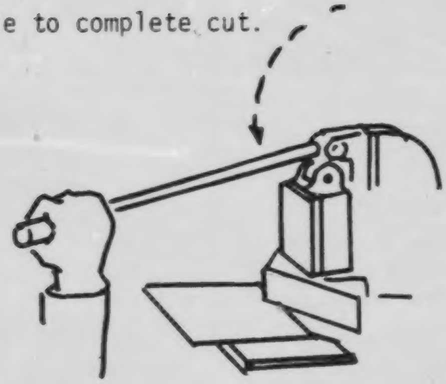
4. Pull down on operating handle until blade makes contact with metal.



5. Adjust stop screw to the desired depth of cut.



6. Pull handle to complete cut.



7. Raise handle and remove work.

OPERATION SHEET
SC-3-19

COMPETENCY: Cut Metal with a Hack Saw

COURSE: Sheet Metal

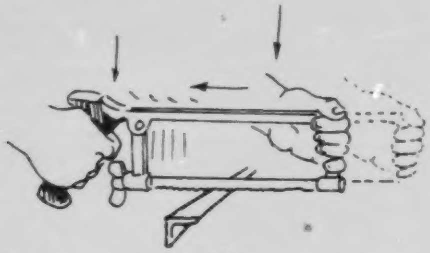
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly use the hack saw

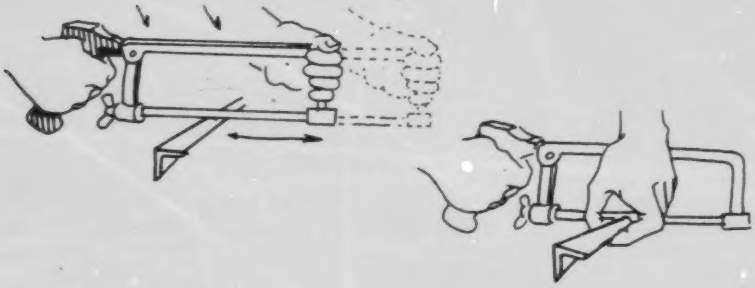
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Hold saw as shown.



2. Start cut by pulling saw back (lightly).
3. Push saw forward (firmly).
4. Pull saw back (lightly).
5. Continue sawing until the cut is complete.
6. Near end of cut, ease up on forward pressure and slow down to avoid slipping and injury.



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OPERATION SHEET
SC-3-20

COMPETENCY: Put Drill Bit into a Drill Motor Chuck

COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to install a drill bit - acceptable to safety standards

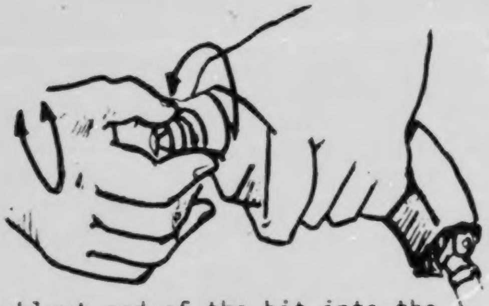
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

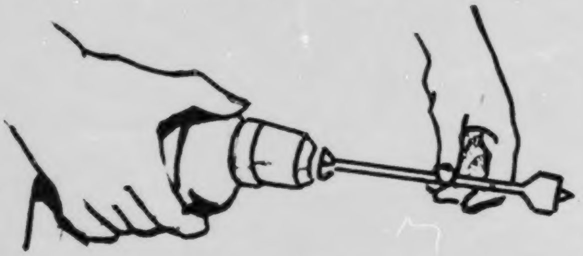
CAUTION: Do not have the drill plugged into the outlet while putting in the drill bit.

1. Open the chuck by turning it counterclockwise with

NOTE: Open it until the drill bit will slide into the chuck.

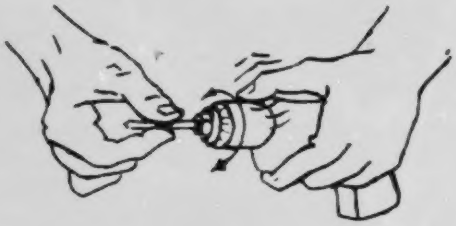


2. Push the blunt end of the bit into the chuck until it bottoms.



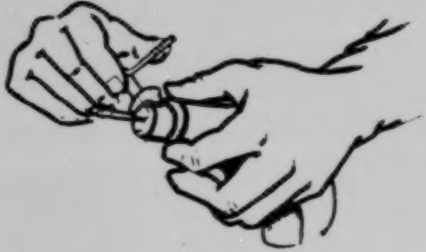
3. Hold the bit in the center of the chuck and turn the chuck clockwise by hand.

NOTE: Make sure the bit is centered in the chuck.



4. Tighten the chuck by turning the chuck key clockwise until it is tight.

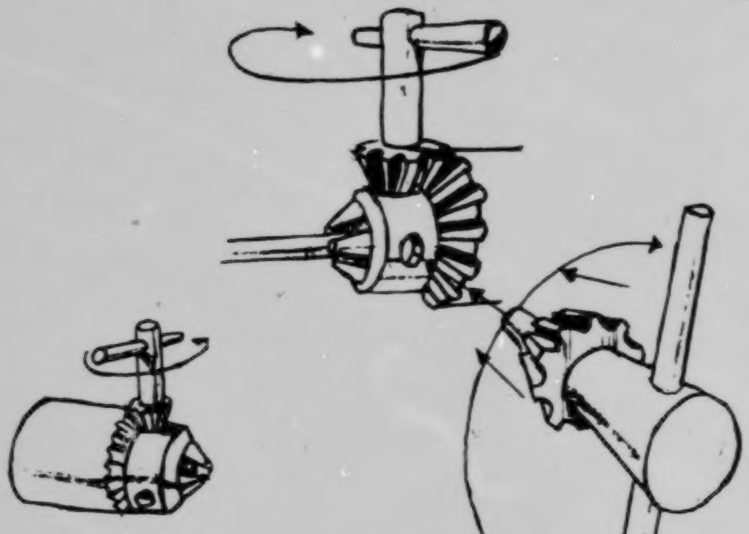
5. Move to each key guide and tighten.



NOTE: Remove the key before using the drill.

5. Plug the drill into an outlet and squeeze the trigger until the drill starts.

NOTE: The bit should run true and not wobble. If the bit wobbles, go back to step 1 and start again.



OPERATION SHEET

SC-3-20A

COMPETENCY: Drill Holes in Sheet Metal with the Hand Electric Drill

COURSE: Sheet Metal

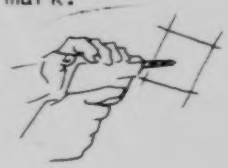
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly drill holes with the electric hand drill

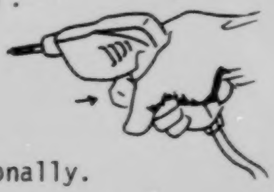
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Place drill bit on punch mark.

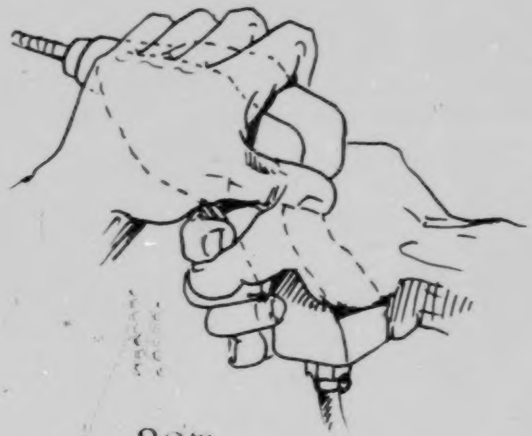


2. Squeeze the trigger and apply firm pressure to drill .



3. Apply oil occasionally.

4. Continue drilling to desired depth.



OPERATION SHEET
SC-3-21

COMPETENCY: Bend Sides on a Box or Pan on the Box and Pan Brake

COURSE: Sheet Metal

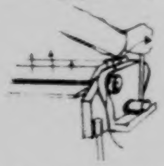
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly adjust and use the box and pan brake

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

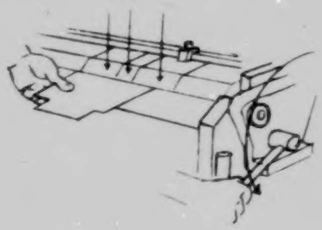
1. Open the brake by raising the operating handle to its highest position.



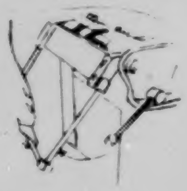
2. Put the work between the jaws from the front of the brake.

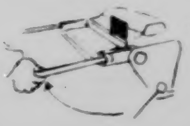
3. Put the long side of the sheet in the brake and push down the clamping handle to clamp the metal in place.

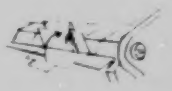
NOTE: Be sure the line to be bent is in line with the center of the upper clamping bar jaw.



4. Bend the side 90° by pulling up on the bending leaf handle with right hand.

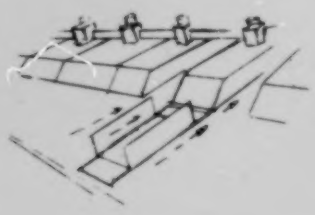




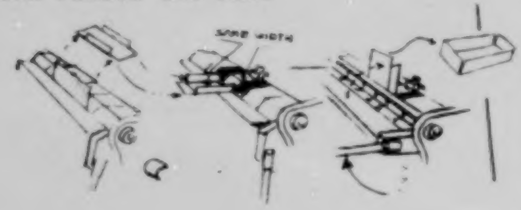


COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES

5. Raise the clamping handle and remove the job.
6. Bend the opposite side of the box in the same way.
7. Raise the clamping handle to its highest position and remove the work.
8. Remove sections from the upper clamping bar until the section left is as long as the box or pan is wide.



9. Bend the last two sides of the box.
10. Open the brake jaws by raising the clamping handle to its highest position and remove the box.



OPERATION SHEET
SC-3-22

COMPETENCY: Punch Holes in Metal on Turret Punch

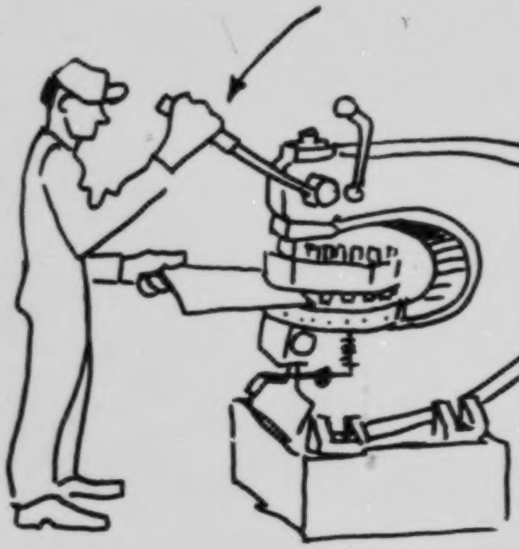
COURSE: Sheet Metal

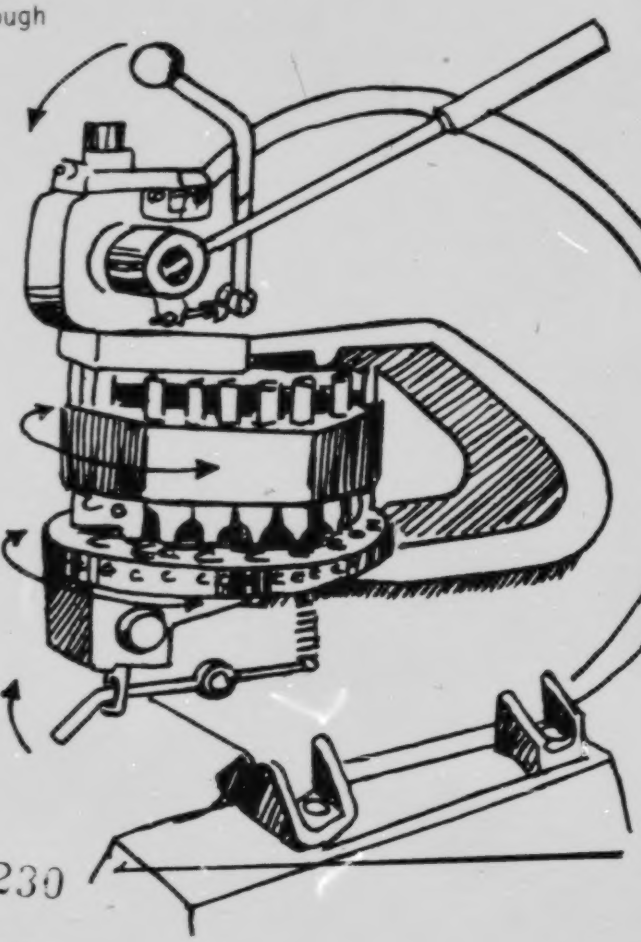
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to rapidly punch holes with turret punch observing utmost safety and without damage to machine

Page 1 of 1 page

COMPETENCY - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Pull top handle forward and index top turret to desired size.	
2. Pull bottom handle up and index bottom turret to same size as top punch.	NOTE: Some models have single level control for top and bottom turret.
3. Insert metal as shown.	
4. Pull handle down until prick mark can be aligned with punch.	
5. After alignment, pull handle through until hole is punched.	
6. Raise handle and remove metal.	





OPERATION SHEET
SC-3-23

COMPETENCY: Spot Weld Metal on the Spot Welder

COURSE: Sheet Metal

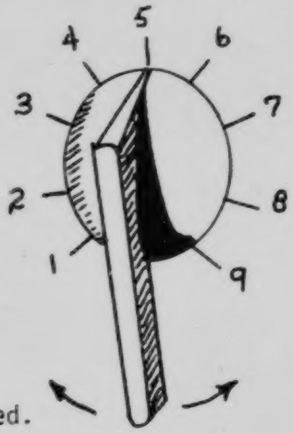
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to accurately and neatly spot weld with the spot welder

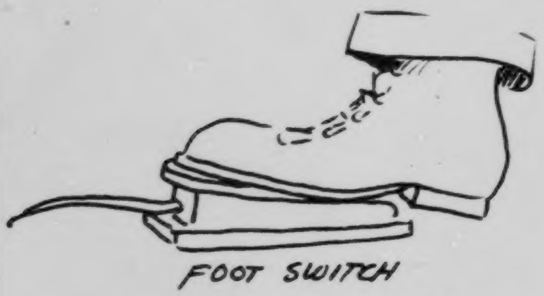
Page 1 of 1 page

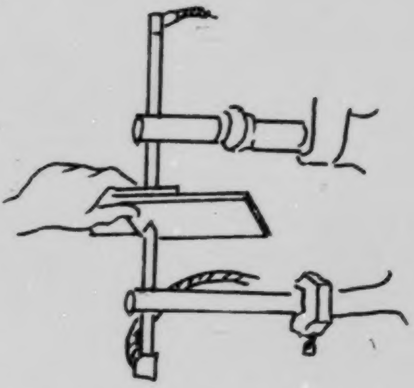
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Select correct amp and timer setting.



2. Dress points if needed.
3. Place metal between points causing electrodes to make contact with metal.





4. Weld by applying pressure to the foot switch.

NOTE: Continued pressure will cause welding.

5. Release pressure when weld is completed.

OPERATION SHEET
SC-3-24

COMPETENCY: Form Cylindrical Shapes on the Slip Roll Forming Machine

COURSE: Sheet Metal

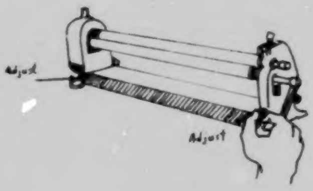
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to learn the proper and efficient use of the slip roll machine

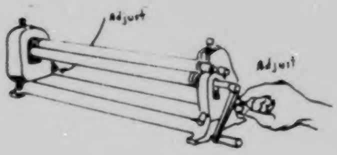
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

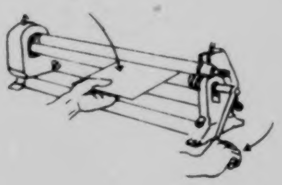
1. Adjust the lower front roll to grip the metal.



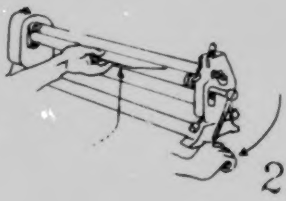
2. Set the back roll.



3. Put the sheet between the rolls from the front of the machine.



4. Turn the operating handle and start the sheet between the rolls.



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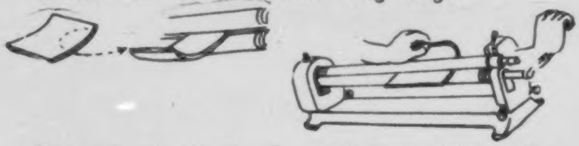
COMPETENCE - PROCEDURE/STEPS

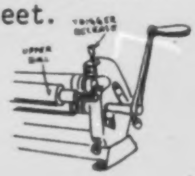
TEACHING/LEARNING ACTIVITIES

5. Holding the operating handle firmly with right hand, raise the sheet with left hand and form a starting edge.

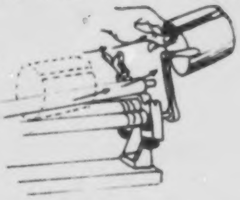


6. Repeat steps 3, 4, and 5 at the other end of the sheet.

7. Turn the operating handle until the sheet is part way through the rolls and then move left hand to the upper edge of the sheet.



8. Roll the rest of the sheet through the machine.



NOTE: If the diameter is not small enough, tighten the back roll and run the sheet through again.

9. Release the upper roll and remove the job.

OPERATION SHEET
SC-3-25

COMPETENCY: Burr an Edge on the Burring Machine

COURSE: Sheet Metal

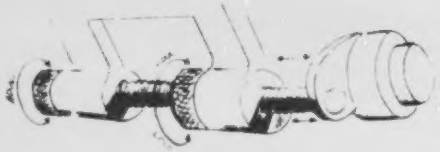
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly adjust and burr on the burring machine

Page 1 of 2 pages

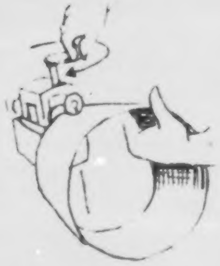
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

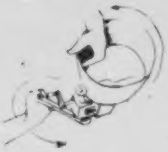
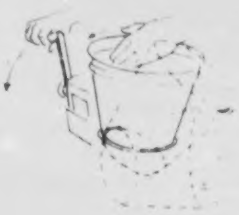
1. Set the gage to the needed depth.
2. Lock the gage in place.



3. Holding the metal in left hand, place the edge to be burred between the rolls and against the gage in a position slightly above horizontal.
4. Bring the upper roll down by turning the crankscrew until the metal is held just tight enough to be drawn through the rolls.

NOTE: Do not overtighten the crankscrew or the metal might be cut.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
5. Hold the metal against the part of the gage between the rolls and turn the operating handle.	NOTE: Let the metal be drawn through the rolls, but always keep the metal touching the gage.
	
6. After the metal has gone around once, raise the metal slightly and make another complete turn.	
7. Continue raising and turning the metal until the proper edge angle is reached.	
	
8. Turn the crankscrew up to release the metal and remove the job from the burring machine.	

OPERATION SHEET
SC-3-26

COMPETENCY: Shear Circular Shapes on Ring and Circle Shears

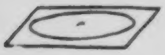
COURSE: Sheet Metal **UNIT III:** Hand Tools and Machines

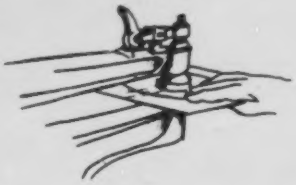
OBJECTIVE: The student will be able to learn the proper use of the ring and circle shears

Page 1 of 2 pages

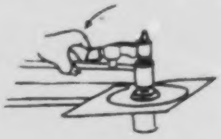
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Holding the blank in right hand, put the prick punch mark on the center point of the lower clamping disc.

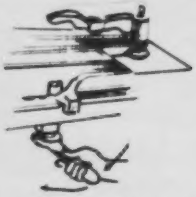




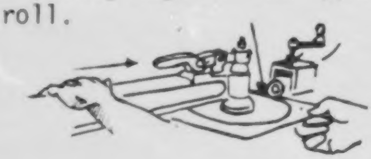
2. Clamp the blank in place by pushing the clamping handle down with left hand.



3. Loosen the lock nut on the sliding circle arm.

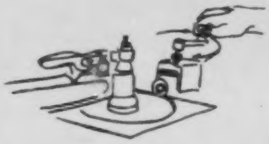


4. Slide the circle arm so that the edge of the scribed circle on the blank is flush with the cutting edge of the upper cutting roll.

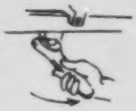


COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES

5. Turn the blank by hand to make sure the cutters are in line with the scribed line on the blank.

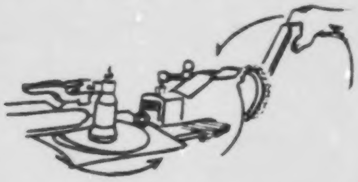


6. Tighten the lock nut on the sliding circle arm.



7. Set the lock nuts on the upper adjustment handle so that the upper cutter makes a clean cut when it is in its lowest position.

8. Turn the operating handle with right hand until the circle has been cut.



9. Release the clamping handle and remove the disc.

OPERATION SHEET
SC-3-26A

COMPETENCY: Make Irregular Cuts on Ring and Circle Shear

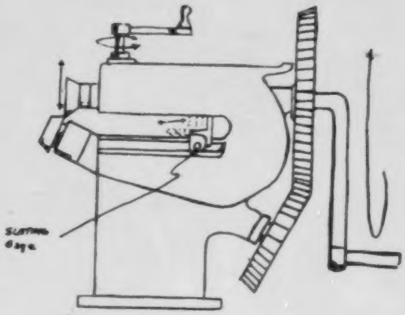
COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

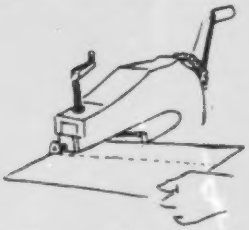
OBJECTIVE: The student will be able to accurately and safely make straight and irregular cuts on the ring and circle shears

Page 1 of 2 pages

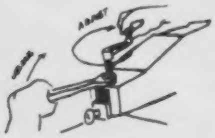
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set the slitting gage.	NOTE: For irregular cuts, don't set the slitting gage.

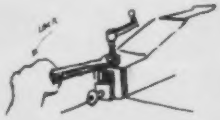


2. Put the line to be cut between the rolls.

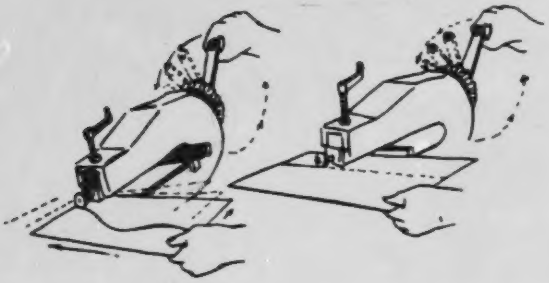


3. Set the lock nuts on the upper adjustment handle so that the upper cutter in its lowest position makes a clean cut.





COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
4. Follow the line with the cutter rolls and turn the operating handle.	NOTE: Feed the sheet away from the operator when it is possible.



OPERATION SHEET
SC-3-27

COMPETENCY: Set Down a Single Seam with the Setting Down Machine

COURSE: Sheet Metal

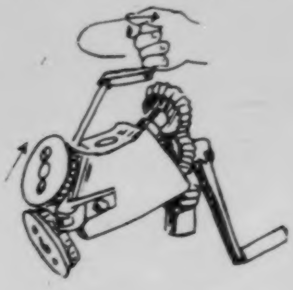
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly use the setting down machine to make a snug, tight, single seam

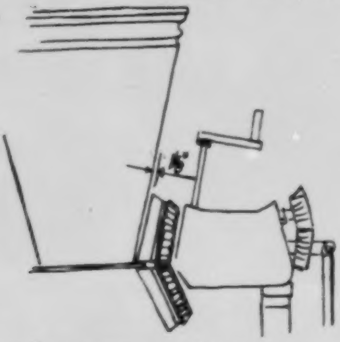
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

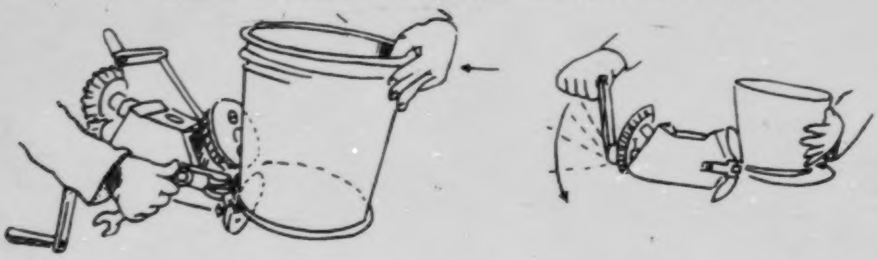
1. Raise the upper roll with the crankscrew.



2. Set the gage to 1/8" shorter than the single seam.



3. Place the single seam, with the open edge up, between the rolls and against the gage.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
4. Lower the upper roll to smash the metal snug.	NOTE: Make the seam snug but do not overtighten or the opposite side of the seam will be scored.
5. Hold the work level and against the gage with left hand.	
6. Turn the operating handle with right hand to make a complete turn of the work. 	
7. Repeat steps 4, 5, and 6 until the seam is snug and there are no buckles in the metal.	
8. Raise the upper roll and remove the work.	

OPERATION SHEET
SC-3-28

COMPETENCY: Form a Double Seam on the Double Seaming Machine

COURSE: Sheet Metal

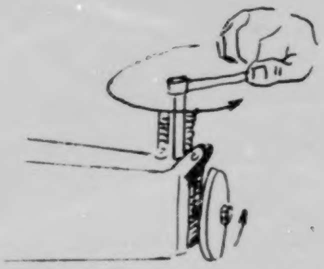
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly set down a secure double seam

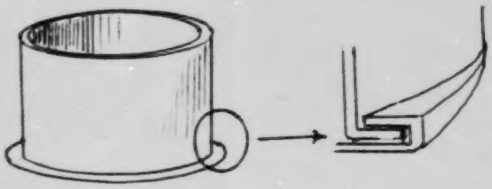
Page 1 of 3 pages

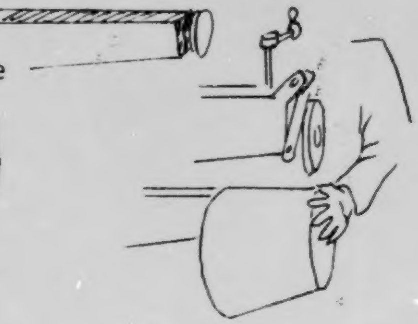
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Raise the upper roll by turning the crankscrew.



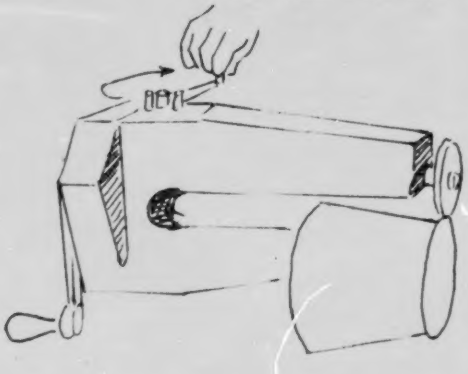
2. Place the work in the machine over the lower roll.





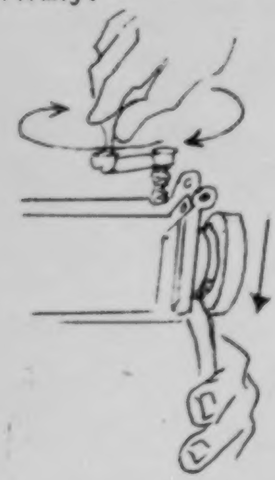
3. Move the lever that positions the upper roll to the left as far as it will go.

NOTE: This places the bevel face of the upper roll in position for the first bend.

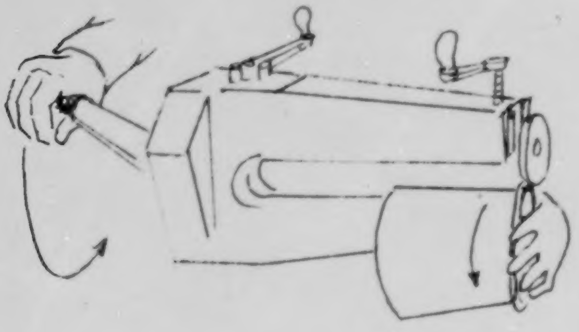


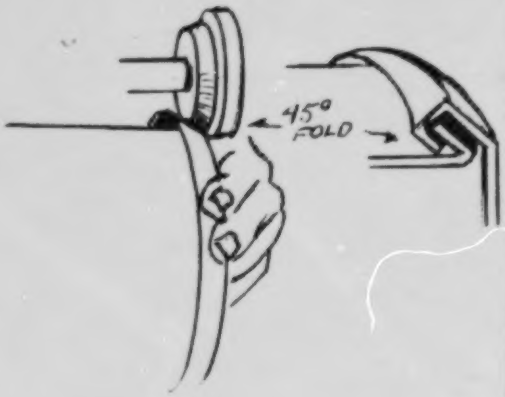
4. Lower the upper roll by turning the crankscrew with right hand until the metal is held firmly.

NOTE: Do not over-tighten the roll or the metal will buckle out.



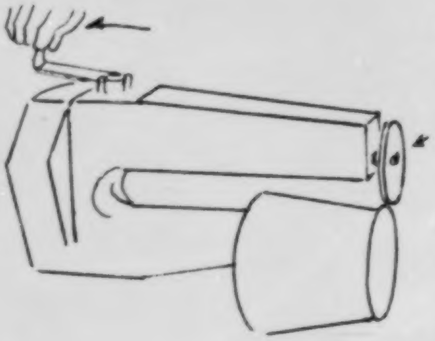
5. Hold the work with left hand and turn the operating handle until the seam is turned to a 45° angle.





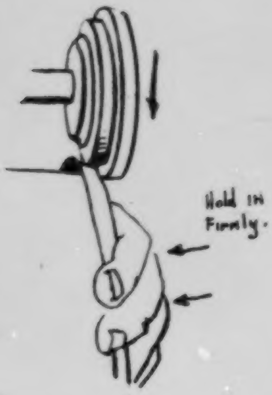
6. Raise the upper roll by turning the crankscrew.

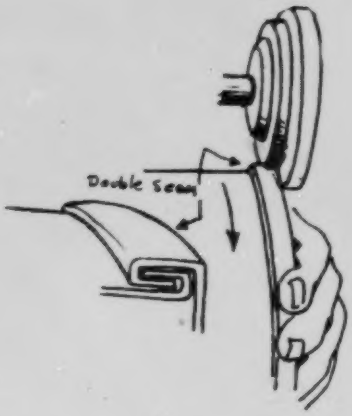
7. Move the lever that positions the upper roll to the right as far as possible.



8. Lower the upper roll by turning the crankscrew with left hand and turn the operating handle to set the double seam down flush with the job.

9. Release the upper roll and remove the job.





COMPETENCY: Form a Double Seam on Stakes Using a Mallet

COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly form a double seam on stake with a mallet making sure that the edges are square and the seam is straight

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

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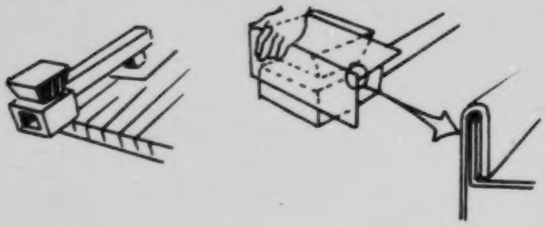
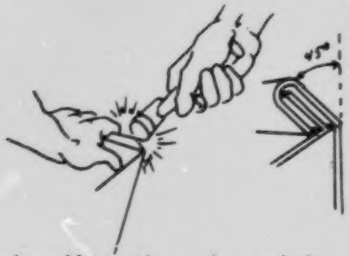
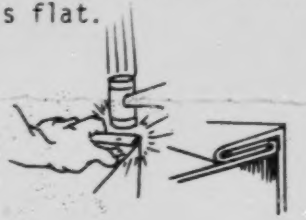
1. Hold the job firmly on the stake.



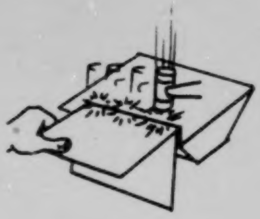
2. Starting at the top of the job, bend the single seam to about a 45° angle by striking inward blows with a mallet.



3. Finish bending the edge with a mallet until the seam is flat.



4. Remove the job from the stake.
5. Put the job back on the stake as shown.



6. Tap the bottom with a mallet to square the edges and straighten the seam.

OPERATION SHEET
SC-3-29

COMPETENCY: Assemble a Wired Edge on Stakes Using Pliers and Setting Down Hammer

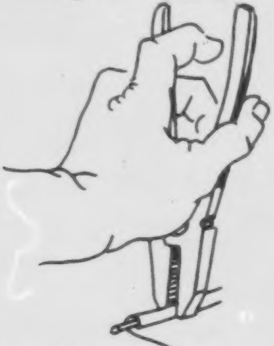
COURSE: Sheet Metal **UNIT III:** Hand Tools and Machines

OBJECTIVE: The student will be able to gain workable knowledge of holding wire in position and setting the metal over the wire in a good workman-like manner

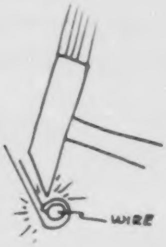
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Place job over stake so that the edge to be wired is bucked up solidly.
2. Grasp pliers with left hand as shown and open wide enough to grasp wire and metal pocket.

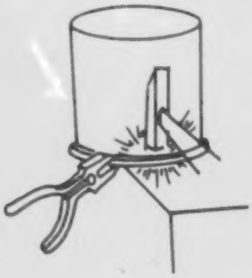


3. Squeeze the pliers so that the wire is pushed back firmly into the pocket of the sheet metal edge.
4. Lock the wire into place by pounding the metal over the wire.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES

5. Continue around the job until the wire is completely seated into pocket.



6. Finish the wired edge by pounding the metal over the wire with the setting down hammer (as shown) or on the wiring rolls.

OPERATION SHEET
SC-3-30

COMPETENCY: Measure Using Inside Calipers

COURSE: Sheet Metal

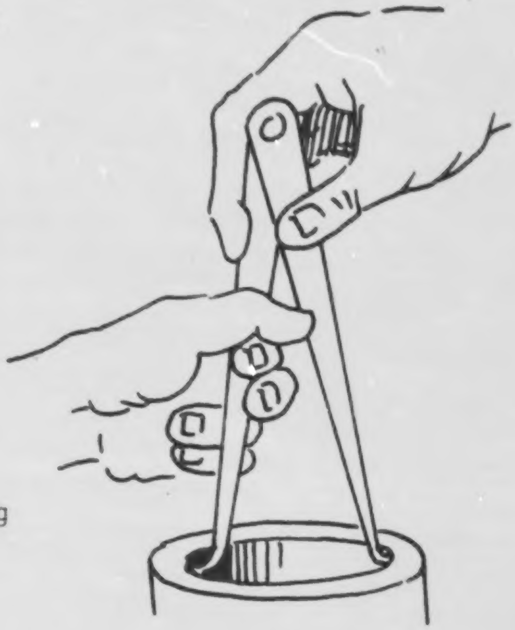
UNIT III: Hand Tools and Machines

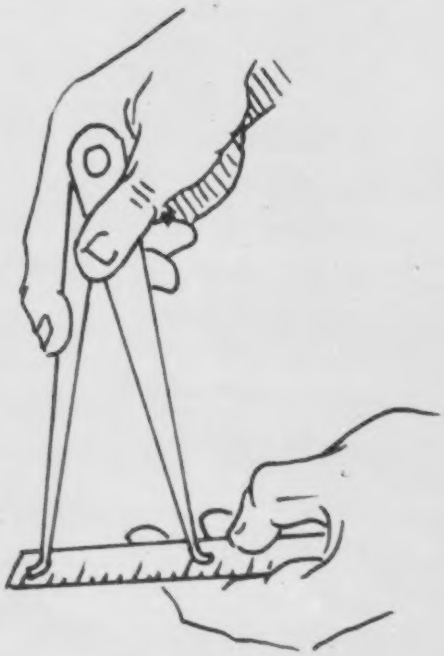
OBJECTIVE: The student will be able to measure inside dimensions accurately using calipers

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Adjust calipers to be smaller than object to be measured.
2. Align calipers with object.
3. Adjust until slight tension is felt.
4. Remove caliper and measure size of opening with rule. (as shown)





OPERATION SHEET
SC-3-31

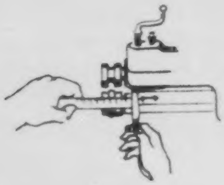
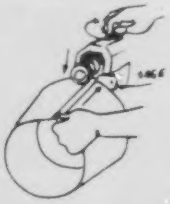
COMPETENCY: Form Beads with the Combination Rotary Machine

COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly bead metal and become familiar with the beading machine

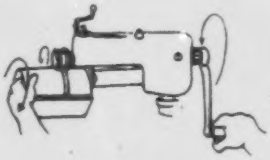
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set the gage on the lower arm of the machine to the distance the bead will be from the edge of the work and fasten the gage with the thumb screw.	NOTE: Do this with a rule or scale.
	
2. Put the work--just to the right of the seam--between the rolls with the edge of the work tight against the gage.	
	
3. Hold the work level with left hand.	
4. Lower the upper roll until the work is held tightly enough to be pulled through the rolls.	

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

5. Keep supporting the work with left hand and turning the operating handle counterclockwise until the seam is reached.



6. Remove the work and turn it past the seam.

7. Put the work back in and lower the upper roll a little more and turn the work around to the seam.

8. Repeat steps 6 and 7 as often as needed.

9. Remove the work.

OPERATION SHEET
SC-3-32

COMPETENCY: Measure Using Outside Calipers

COURSE: Sheet Metal

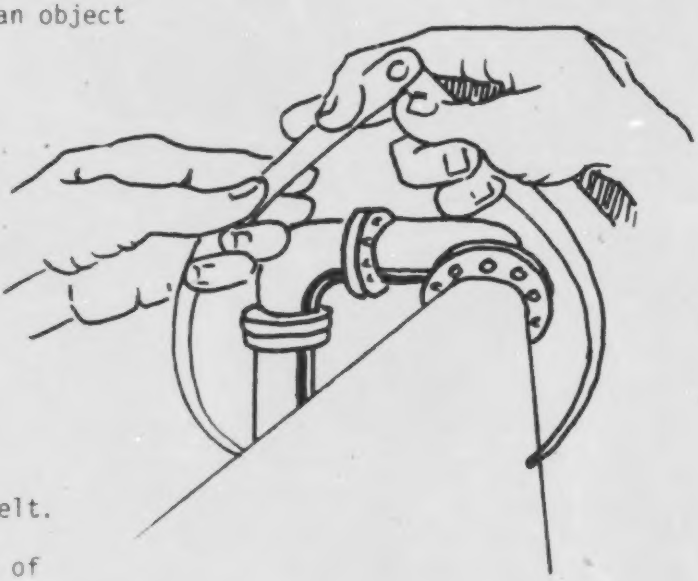
UNIT: Hand Tools and Machines

OBJECTIVE: The student will be able to measure outside dimensions accurately using calipers

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

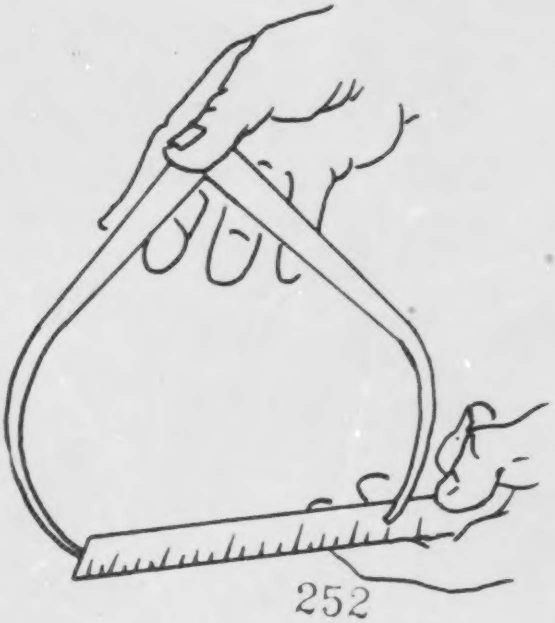
1. Adjust caliper opening larger than object to be measured.



2. Align calipers with object.

3. Adjust until slight tension is felt.

4. Remove calipers and measure size of opening with rule. (as shown)



OPERATION SHEET
SC-3-33

COMPETENCY: Cut Metal on the Band Saw

COURSE: Sheet Metal

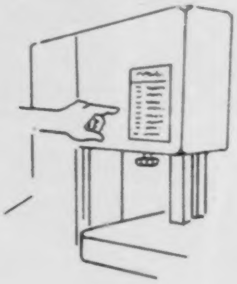
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to operate the band saw in an efficient manner with proper safety

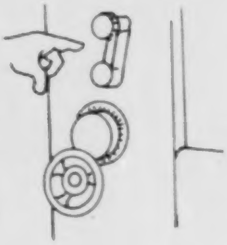
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

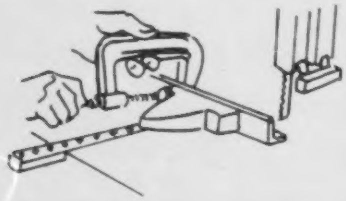
1. Select the proper speed for cutting.



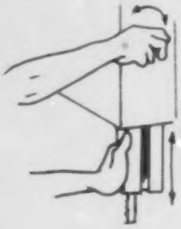
2. Set speed control.



3. Clamp work down properly.

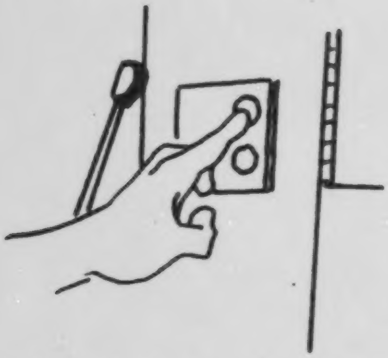


4. Set saw guide for proper height.



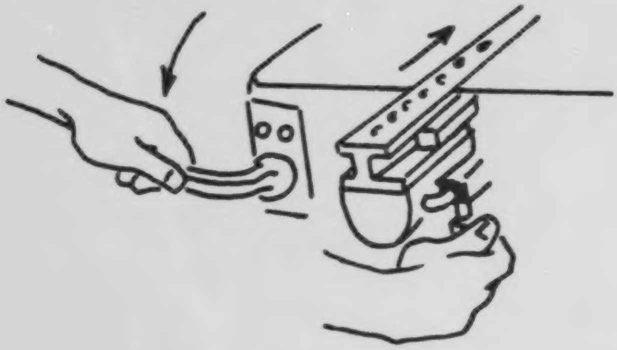
253

5. Turn on saw.



6. Set speed control for correct feeding speed.

7. Put automatic feed control to forward gear to start the cut.



8. Make cut.

OPERATION SHEET
SC-3-34

COMPETENCY: Form Round Tapers on Bench Stakes by Hand

COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

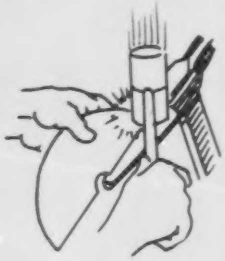
OBJECTIVE: The student will be able to accurately form neat round tapers on bench stakes

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

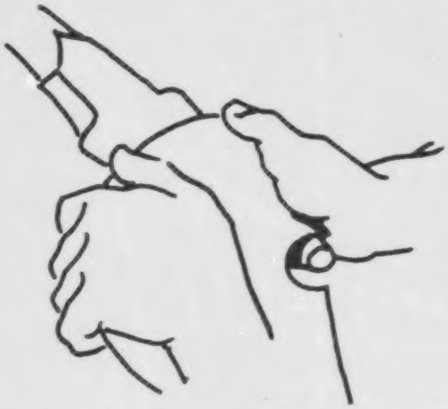
1. Place the proper stake in the bench plate.

2. Hold the edge of the metal over the stake with the left hand, and with a mallet in the right hand start the bend.



3. Repeat step #2 on the opposite side.

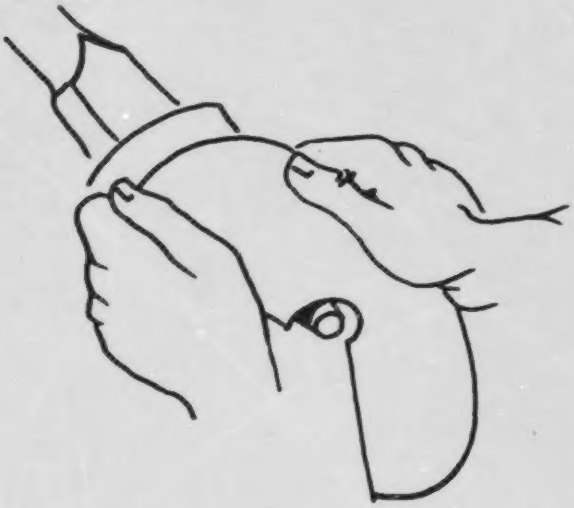
4. Hold the bent edge over the stake with the right hand and bend the metal around the stake with the left hand.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES

5. Slide the job across the stake until the left edge is over the stake.

6. Hold the edge of the metal with the left hand and form the job around the stake with the right hand.



OPERATION SHEET
SC-3-34A

COMPETENCY: Form a Transition on Stakes with Mallet

COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

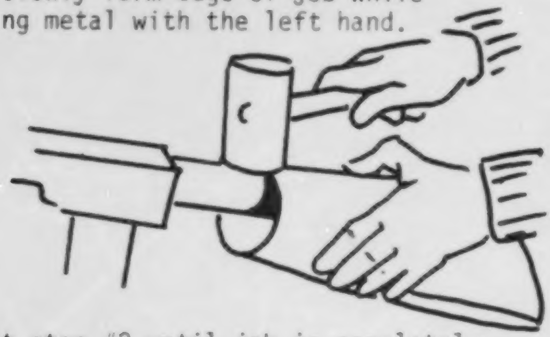
OBJECTIVE: The student will be able to properly form metal on stakes using a mallet

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

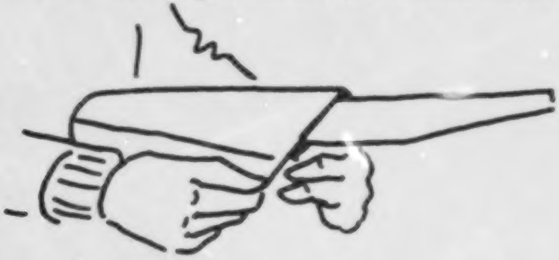
1. Select proper stake and place it on the bench plate.

2. Slide the metal over the stake and hold job on surface of stake with left hand (or right) and with mallet in the right hand slowly form edge of job while turning metal with the left hand.



3. Repeat step #2 until job is completely formed.

4. Form a square base using the hatchet stake by holding the bent edge over the stake with the left hand and bending the metal down with the right hand. (As shown below)



OPERATION SHEET
SC-3-35

COMPETENCY: Roll Tapered Shapes on the Slip-Roll Forming Machine

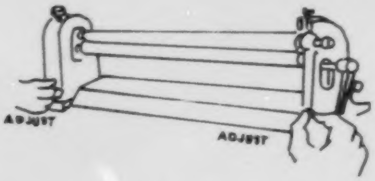
COURSE: Sheet Metal

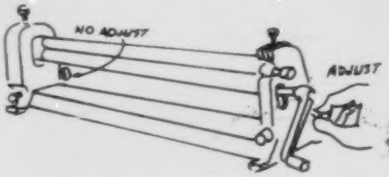
UNIT III: Hand Tools and Machines

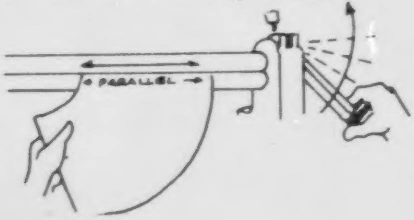
OBJECTIVE: The student will be able to learn the proper and efficient use of the slip roll machine

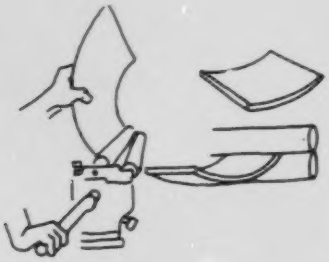
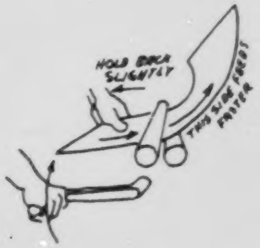
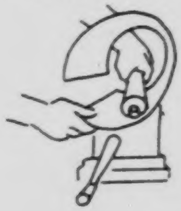
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Raise or lower the front bottom roll so the sheet can be put in.	
2. Set the back roll so that it is near the taper of the job.	
3. Put the sheet between the rolls with the seam parallel to them.	NOTE: Put the sheet in from the front of the machine.
4. Start the sheets through by turning the operating handle with right hand.	







COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
5. Hold the operating handle firmly with right hand and lift the sheet with left hand. 	NOTE: This forms the starting edge.
6. Repeat steps 3, 4, and 5 on the other end.	
7. Turn the operating handle with right hand and hold the back of the small side of the taper with left.  HOLD BACK SLIGHTLY THIS SIDE FEEDS FASTER	NOTE: Keep turning the taper through the rolls as though it were a circle with its origin at the end of the roll.
8. Loosen the upper roll and remove the job.	
9. If the roll is not tight enough, tighten the back roll and put the sheet through again. 	

OPERATION SHEET
SC-3-36

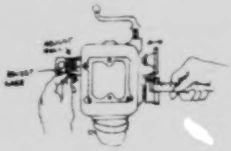
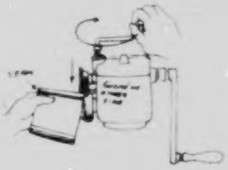
COMPETENCY: Form Metal on the Turning Machine

COURSE: Sheet Metal

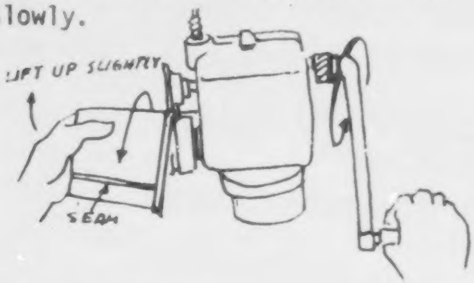
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly adjust and operate the turning machine

Page 1 of 2 pages

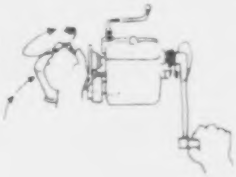
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Set the gage for the width of edge wanted. 	
2. Beginning near the seam, put the edge to be turned against the gage.	NOTE: Hold the other end of the job slightly higher with fingers inside and thumb on top.
3. Lower the upper roll until it makes a light mark on the metal. 	
4. Hold the edge of the job against the gage and turn the operating handle counterclockwise until the job has turned one turn, stopping at the seam.	

5. Lower the upper roll until a sharp increase in tension is felt, but do not lower it enough to crease the metal, and raise the free end of the job slowly.

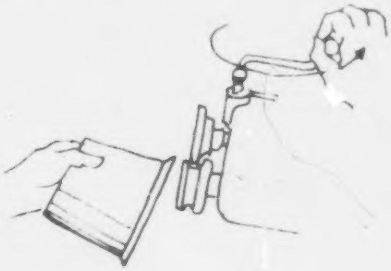


6. Turn the job through again.

7. Repeat steps 5 and 6 as often as needed.



8. Raise the roll and remove the job.



OPERATION SHEET
SC-3-37

COMPETENCY: Shear Metal with the Unishear

COURSE: Sheet Metal

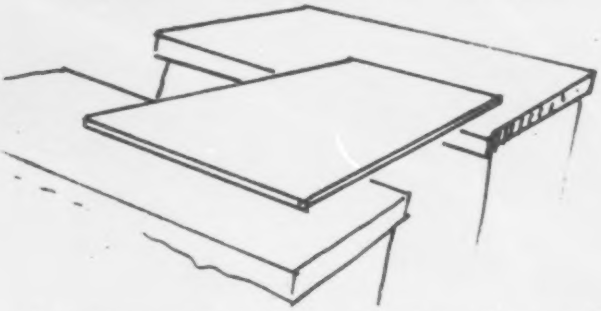
UNIT III: Hand Tools and Machines

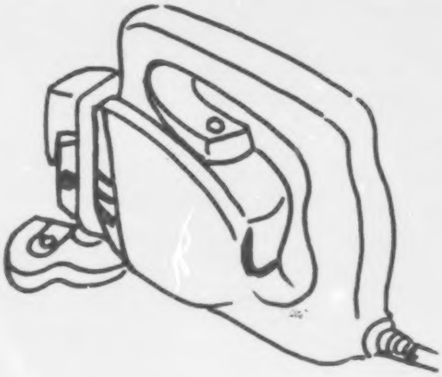
OBJECTIVE: The student will be able to properly adjust and guide the unishear to make a good clean cut

Page 1 of 2 pages

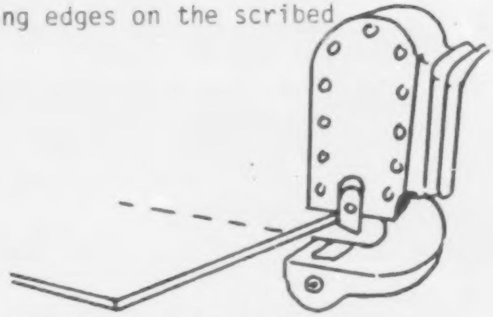
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Adjust the cutting blades to the proper setting. (This is regulated by the metal thickness you are cutting.)

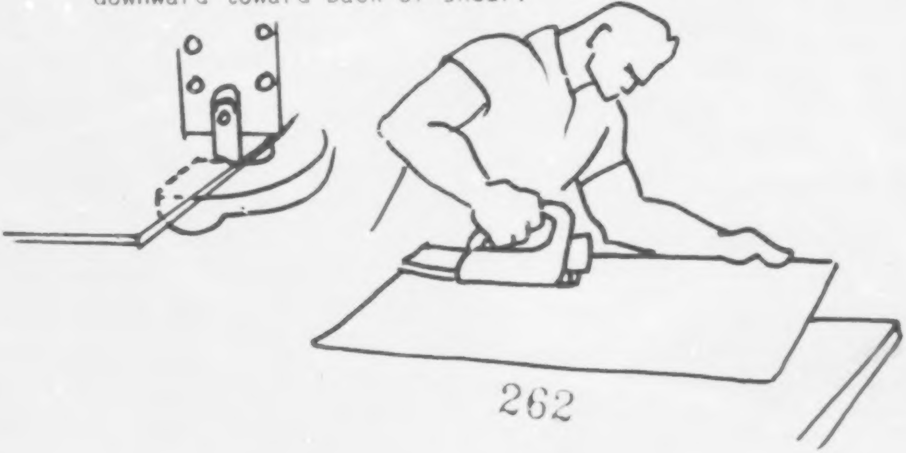




2. Place the cutting edges on the scribed line to be cut.



3. Start the cutter and with a slow steady forward motion, move the unishear blades along the scribed line, applying pressure downward toward back of shear.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
4. Stop the unishears and check the portion that has been slit or cut.	NOTE: There should be no rough or jagged edges, if there are, readjust the blades so they are closer together.
5. Continue cutting until the entire project is cut.	CAUTION: Do not try to cut through bolts, screws or rivets, it will ruin the cutting edges of the blades.

OPERATION SHEET
SC-3-38

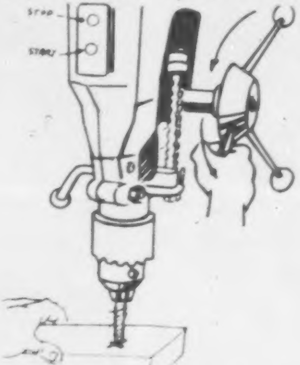
COMPETENCY: Drill Holes in Metal on the Drill Press

COURSE: Sheet Metal

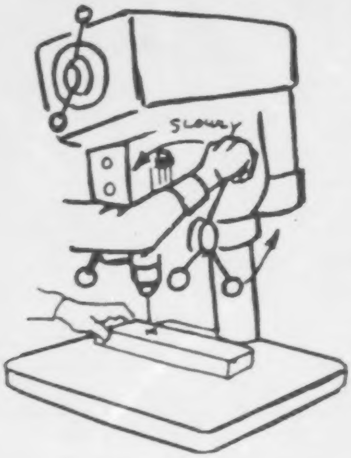
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to use the drill press properly

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the stock firmly with left hand--or clamp if necessary.	
2. Turn on the motor. Turn the feed lever (pilot wheel) counterclockwise to bring the bit close to the surface of the stock.	
3. Move the stock to line up with the lay-out mark.  	
4. Feed the bit into the work slowly with smooth, even pressure.	NOTE: Add cutting fluid when cutting metal.
5. Ease off the pressure when the bit is about to break through the back of the stock.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
6. Raise the bit slowly until it clears the work and release the feed lever.	NOTE: This will automatically return the drill to the "up" position.
7. Stop the machine.	
8. Return all bits and cutters to their proper places, then clean the machine.	



OPERATION SHEET
SC-3-39

COMPETENCY: Adjust and Use an Adjustable Wrench

COURSE: Sheet Metal

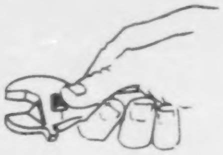
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to adjust and use the wrench in a sufficient manner

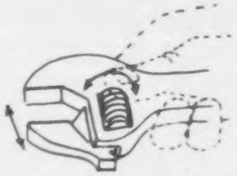
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

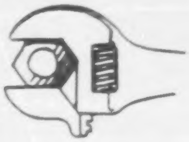
1. Hold adjustable wrench in hand with thumb on the knurled worm gear.



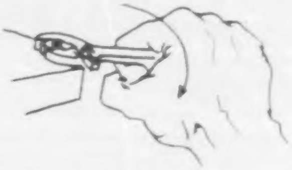
2. Roll the gear with thumb to open or close the jaw of the wrench.



3. Open wrench jaw large enough to fit over the bolt, nut or stud and close jaw on bolt head until it is tight.



4. Turn nut or bolt to tighten or loosen.



OPERATION SHEET
SC-3-39A

COMPETENCY: Tighten and Loosen Fasteners with Allen Wrenches

COURSE: Sheet Metal

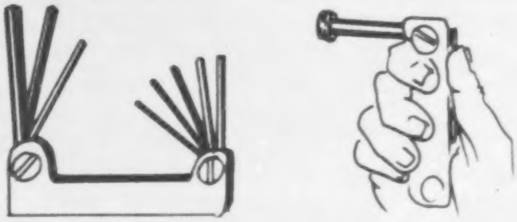
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to use allen wrenches in a safe, efficient manner

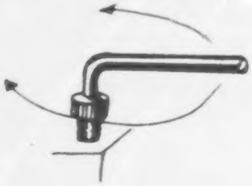
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Insert proper wrench into hex hole in fastener. (If the fit is sloppy, use a larger size.)

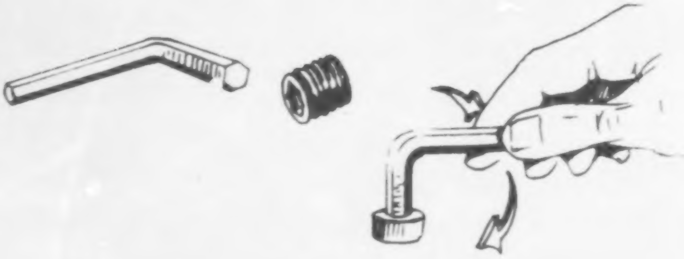


2. Turn fastener clockwise or counter-clockwise to tighten or remove.



NOTE: Insert the short end for more leverage.

NOTE: Insert the long end for hard-to-reach places.



OPERATION SHEET
SC-3-39B

COMPETENCY: Tighten Pipes and Fittings With Pipe Wrenches

COURSE: Sheet Metal

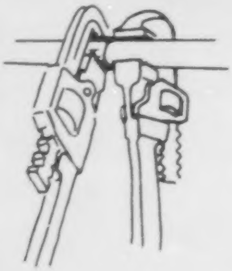
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly tighten pipes with the pipe wrench

Page 1 of 1 page

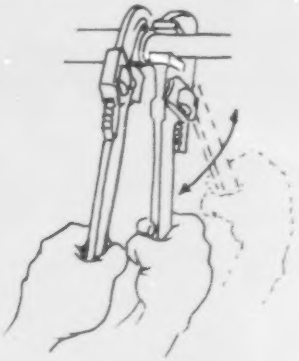
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Place the pipe wrench on the pipe about 2" from the end in a counterclockwise position and place another pipe wrench on the fitting in a clockwise position.



2. Hold the wrench on the pipe steady with one hand and with the other hand, ratchet-on the fitting until it is snug or until it is in line with the connection.

NOTE: Because the threads taper, about one turn is needed to "wrench tighten" a pipe fitting.



OPERATION SHEET
SC-3-39C

COMPETENCY: Use a Socket Wrench With a Breaker Bar

COURSE: Sheet Metal

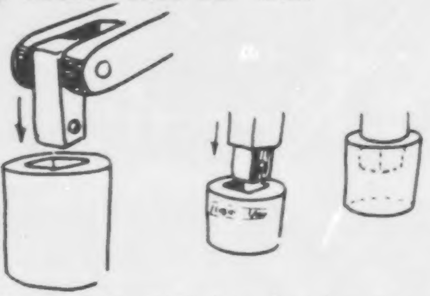
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly tighten or loosen a socket using a socket wrench and breaker bar

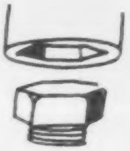
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

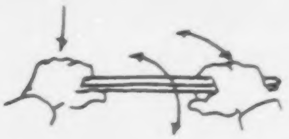
1. Snap socket onto bar end.



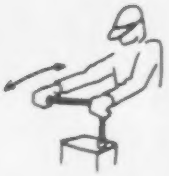
2. Place socket over hex head nut or bolt.



3. Hold socket in place with left hand.



4. Turn bar with right hand.



OPERATION SHEET
SC-3-39D

COMPETENCY: Use Combination Wrenches

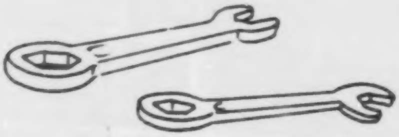
COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

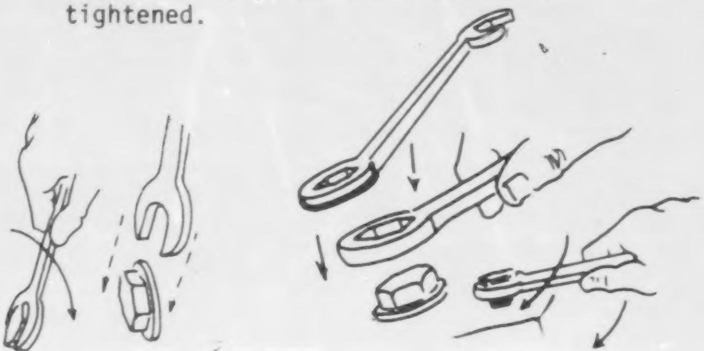
OBJECTIVE: The student will be able to use the proper sized combination wrench to do a good job

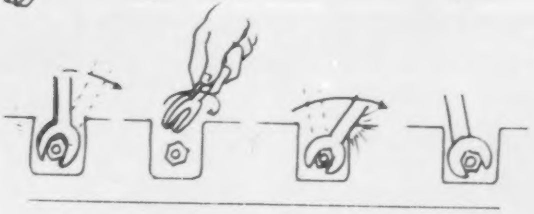
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES



1. Place the proper size box or open wrench over item to be turned--loosened or tightened.





2. Make proper adjustment.

NOTE: The combination wrench is really two wrenches, an open end wrench and a box (hex) wrench.

OPERATION SHEET
SC-3-40

COMPETENCY: Tighten and Loosen Screws with a Flat Screwdriver

COURSE: Sheet Metal

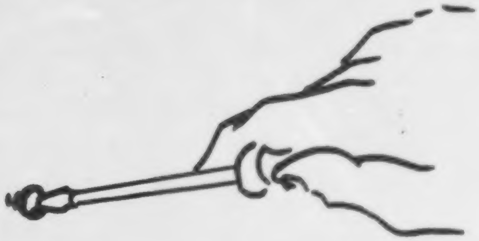
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to use a screwdriver safely and efficiently

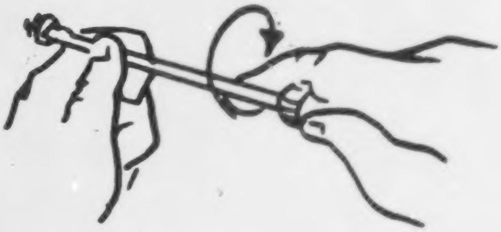
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

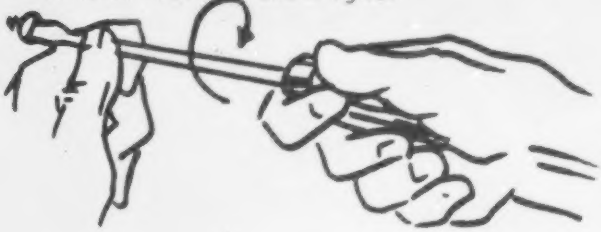
1. Place blade into screw slot as shown.



2. Use thumb and forefinger of left hand to keep blade centered.



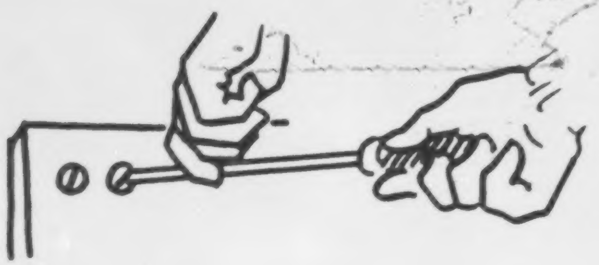
3. With handle of screwdriver in palm of right hand, securing blade with thumb and forefinger of left hand, twist screwdriver to the right.



COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

4. Relax right hand, twist wrist counterclockwise. Repeat step 3.
5. Continue steps 3 and 4 until screw snugs down.
6. Reverse steps 3 and 4 to loosen.



OPERATION SHEET
SC-3-41

COMPETENCY: Cut Internal Threads Using the Tap

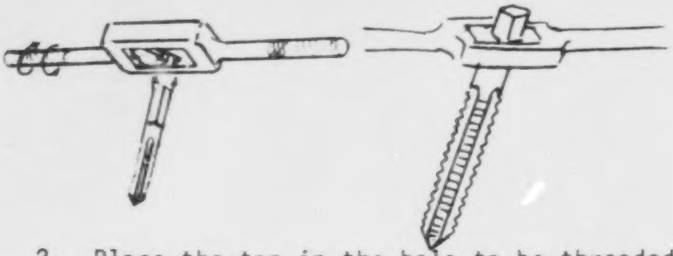
COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

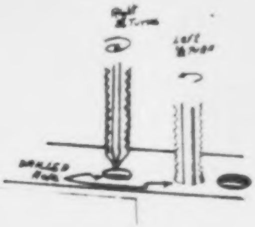
OBJECTIVE: The student will be able to form internal threads efficiently and without breaking the tips

Page 1 of 1 page

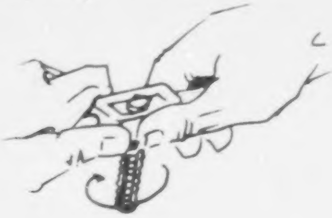
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place the tap in the tap handle.	



2. Place the tap in the hole to be threaded.	
3. Turn the handle clockwise about 2 turns.	



4. Turn handle back when it binds.	
5. Continue turning and backing until desired depth is reached.	NOTE: Use oil while cutting threads.



OPERATION SHEET
SC-3-42

COMPETENCY: Form an Elbow Lock with a Combination Rotary Machine

COURSE: Sheet Metal

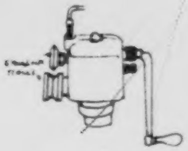
UNIT III: Hand Tools and Machines

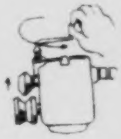
OBJECTIVE: The student will be able to properly adjust and operate the combination rotary machine

Page 1 of 2 pages

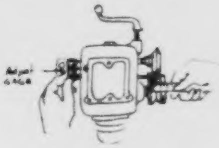
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Raise the upper roll by turning the crankscrew.





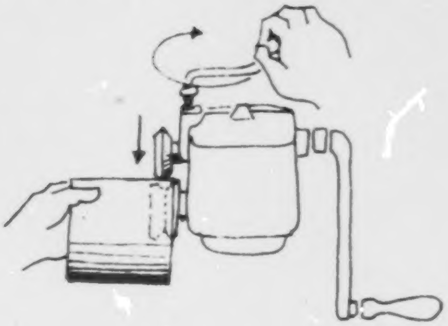
2. Set the gage.



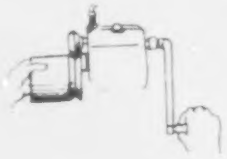
3. Place the edge to receive the elbow lock between the rollers and against the gage.

4. Lower the upper roll by turning the crankscrew until the metal is just drawn into the rolls.

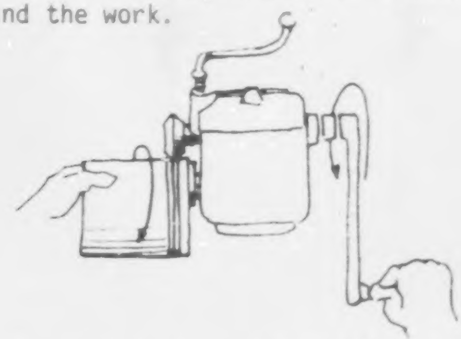
NOTE: Do not overtighten the crankscrew.



5. Hold the work level and keep it against the gage.

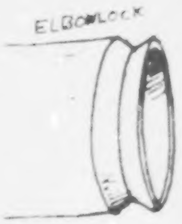


6. Turn the operating handle with right hand until one complete turn is made around the work.



7. Repeat steps 4, 5, and 6 until the elbow lock is the depth wanted.

8. Raise the upper roll and remove the work.



OPERATION SHEET
SC-3-43

COMPETENCY: Crimp Metal with a Combination Rotary Machine

COURSE: Sheet Metal

UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to gain workable knowledge of the crimping machine

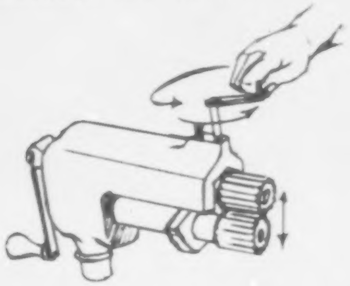
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

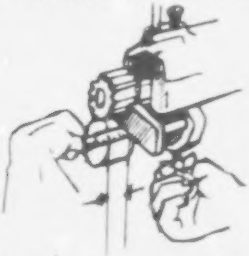
TEACHING/LEARNING ACTIVITIES

---

1. Turn the crankscrew and raise the upper roll of the machine enough to get the metal between the rolls.



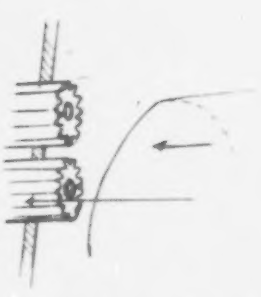
2. Set the gage to the depth wanted.

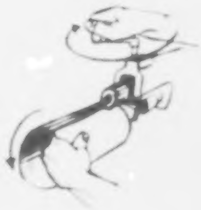


3. Place the edge to be crimped between the rolls and against the gage.

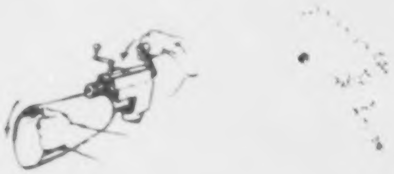
NOTE: The side of the metal should be just past the rolls.

4. Lower the upper roll until the depth crimp wanted is reached.





5. Turn the crankscrew until the operating handle turns with a little stiffness.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
6. Hold the work level against the gage and turn the operating handle until the crimp is made the whole way around. 	NOTE: Do not crimp over seams.
7. Raise the upper roll and remove the work.	

OPERATION SHEET
SC-3-44

COMPETENCY: Offset Metal on the Combination Rotary Machine

COURSE: Sheet Metal

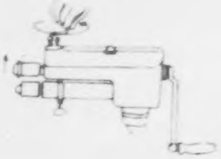
UNIT III: Hand Tools and Machines

OBJECTIVE: The student will be able to properly offset metal and become familiar with the combination rotary machine

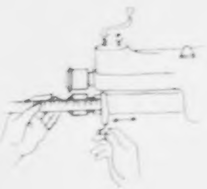
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Raise the upper roll.

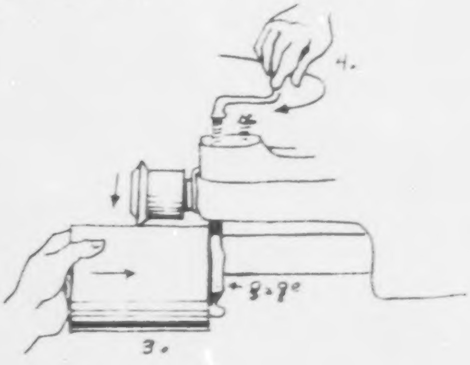


2. Set the gage to the size offset wanted.



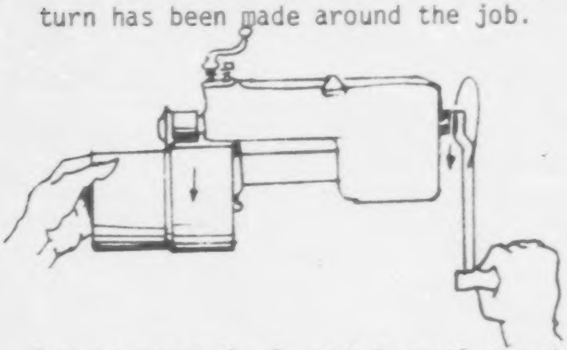
3. Place the edge to be offset between the rolls and against the gage.

4. Turn the crankscrew with left hand and lower the upper roll to grip the metal.



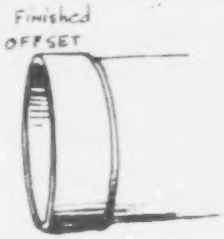
COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
5. With left hand, hold the work level and against the gage.	NOTE: The work must always be kept against the gage.

6. Turn the operating handle until one turn has been made around the job.



7. Repeat steps 4, 5, and 6 until the depth offset wanted is made.

8. Raise the upper roll and remove the work.



OPERATION SHEET
SC-4-1

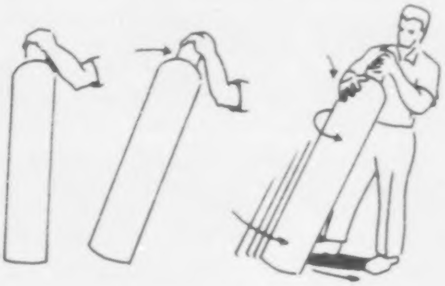
COMPETENCY: Transport Acetylene and Oxygen Cylinders

COURSE: Sheet Metal UNIT IV: Welding

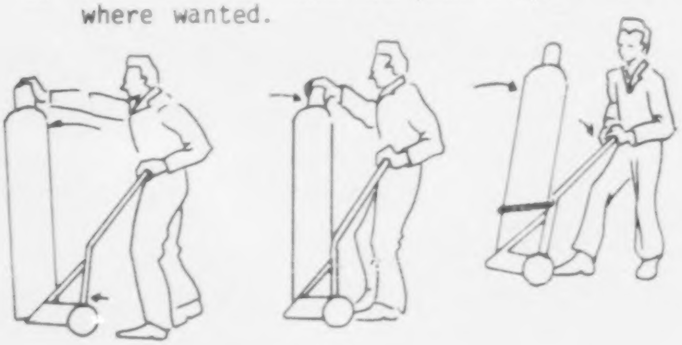
OBJECTIVE: The student will be able to move cylinders into position safely and without physical injury

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Move the cylinder by holding the valve protection cap in left hand and tilting the cylinder toward the left, roll the cylinder with right hand.	NOTE: Tanks should be stored upright.



COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
2. Rock the cylinder onto the cart and strap or chain it so that it will not upset.	NOTE: Move cylinders on an approved cart.
3. Tilt the cart back and push or pull it where wanted.	CAUTION: Never move an oxygen cylinder without the valve protection cap in place. NOTE: Keep the cylinder away from grease, oil, and open flame.



OPERATION SHEET
SC-4-2

COMPETENCY: Set Up Gas Welding Equipment

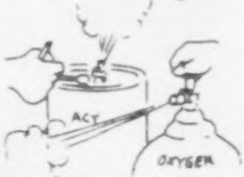
COURSE: Sheet Metal

UNIT IV: Welding

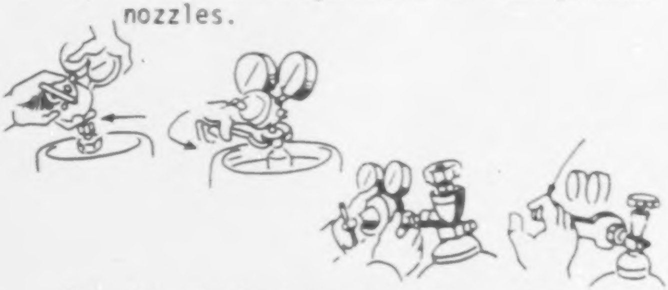
OBJECTIVE: The student will be able to connect gas welding equipment safely and quickly and without damage to equipment

Page 1 of 3 pages

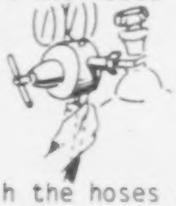
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Crack open and quickly close the cylinder valves before connecting the regulators.	CAUTION: Never open both tanks at the same time.



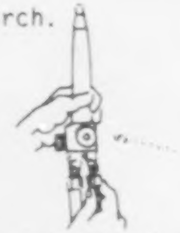
2. Attach the regulators to the cylinder nozzles.	NOTE: The oxygen is right-hand threaded and the acetylene is left-hand threaded.



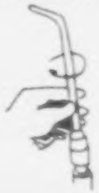
3. Attach the hoses to the regulators.



4. Attach the hoses to the torch.

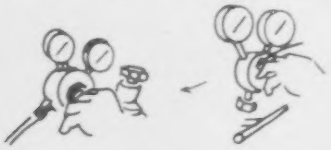


5. Attach the proper tip and mixing head.

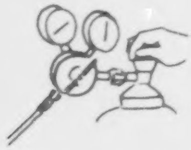


COMPETENCE - PROCEDURE/STEPS

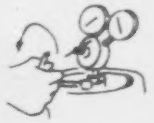
6. Back off the regulator screws on both units until the screws turn freely.



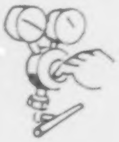
7. Open the oxygen cylinder valve all the way.



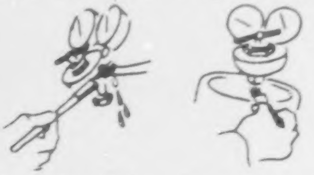
8. Open the acetylene cylinder ¼ to ½ turn counterclockwise.



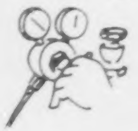
9. Turn the acetylene regulator screw in to adjust the acetylene working pressure.



10. Check the acetylene system with soapy water.



11. Turn the regulator screw on the oxygen in to adjust the working pressure.

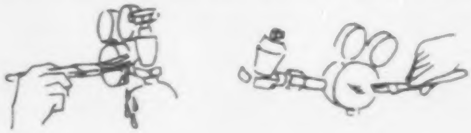


TEACHING/LEARNING ACTIVITIES

NOTE: Be sure both needle valves on the torch are turned off -- clockwise.

NOTE: All oxy-acetylene gages should read no pressure.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
12. Check the oxygen system with soapy water.	



OPERATION SHEET
SC-4-3

COMPETENCY: Close the Oxy-Acetylene Equipment

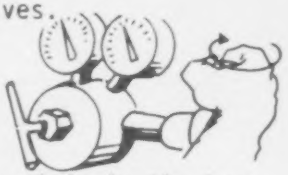
COURSE: Sheet Metal   **UNIT IV:** Welding

OBJECTIVE: The student will be able to safely close down oxy-acetylene equipment

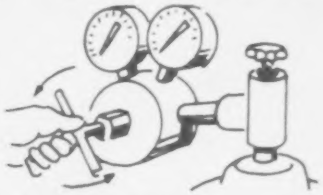
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

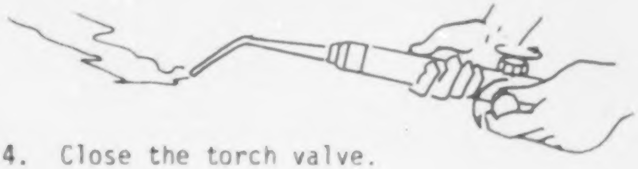
1. Close the cylinder valves.



2. Open the torch valves and drain the hose.



3. Unscrew the regulator pressure keys.



4. Close the torch valve.

5. Put the hose and torch in their proper places.

OPERATION SHEET
SC-4-4

COMPETENCY: Clean Cutting or Welding Tips with a Tip Cleaner

COURSE: Sheet Metal

UNIT IV: Welding

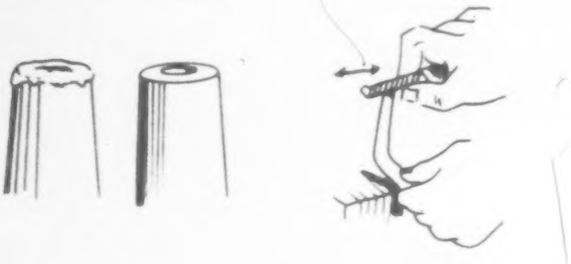
OBJECTIVE: The student will be able to clean welding tips for best results without damage to torch tips

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

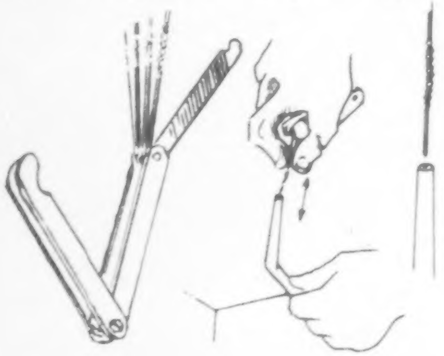
TEACHING/LEARNING ACTIVITIES

1. File the tip edges and face to remove all particles of slag and to bring the tip back to shape.



2. Holding the selected cleaner firmly, clean the opening with an up and down motion.

NOTE: Never ram, twist or turn the cleaner. For a proper tip core the cleaner must float freely.



OPERATION SHEET
SC-4-5

COMPETENCY: Open the Oxy-Acetylene Equipment for Welding

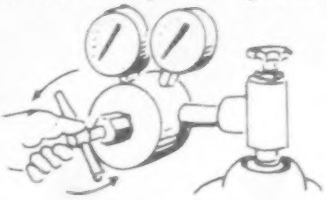
COURSE: Sheet Metal **UNIT IV:** Welding

OBJECTIVE: The student will be able to quickly and safely prepare gas welding equipment for use

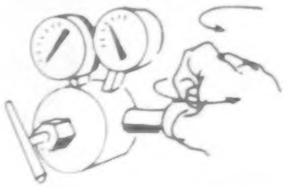
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

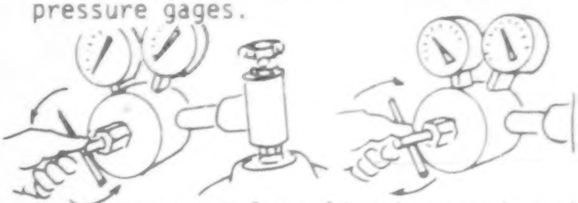
1. Slowly open the acetylene cylinder ¼ to ½ turn.



2. Slowly open the oxygen cylinder valve all the way.



3. Turn the regulator adjusting screws to the proper working pressure on low pressure gages.



4. Purge the acetylene line by opening the acetylene line and then closing it again quickly.

5. Purge the oxygen line by opening the oxygen line and then closing it again quickly.

TEACHING/LEARNING ACTIVITIES

CAUTION: Make sure the regulator adjusting screws are turned out (counter clockwise) until they are free of pressure and that the torch valves are closed.

OPERATION SHEET
SC-4-6

COMPETENCY: Light and Adjust the Torch and Flame

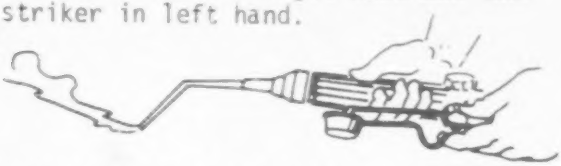
COURSE: Sheet Metal UNIT IV: Welding

OBJECTIVE: The student will be able to light and adjust torch for efficiency and safe operation

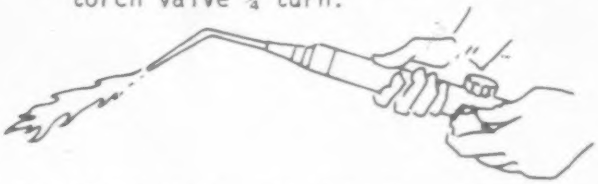
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

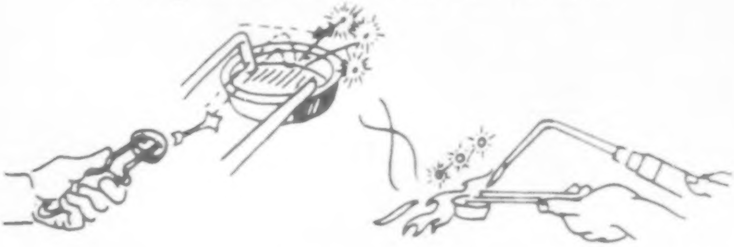
1. Hold the torch in right hand and the striker in left hand.



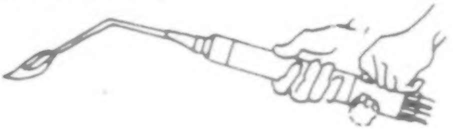
2. With left hand, open the acetylene torch valve ¼ turn.



3. Light the torch with the striker.

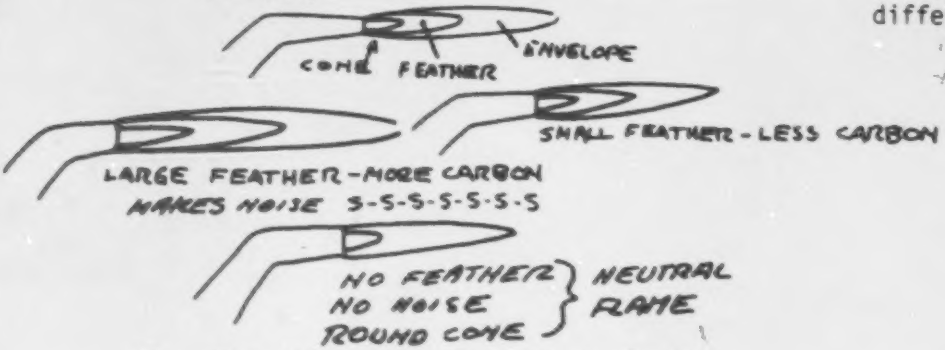


4. Adjust the acetylene flame with the torch valve until the flame is between smoke and blow off.



COMPETENCE - PROCEDURE/STEPS

5. Open the oxygen valve and adjust it to the proper flame.


CONE
FEATHER
ENVELOPE
SMALL FEATHER - LESS CARBON
LARGE FEATHER - MORE CARBON
MAKES NOISE S-S-S-S-S-S-S
NO FEATHER
NO NOISE
ROUND CONE
NEUTRAL FLAME

6. Shut the torch off by first closing the acetylene torch valve.

7. Close the oxygen valve.

TEACHING/LEARNING ACTIVITIES

NOTE: Neutralizing, oxidizing, and carburizing flames are different.

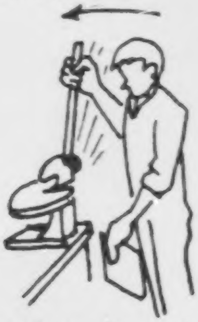
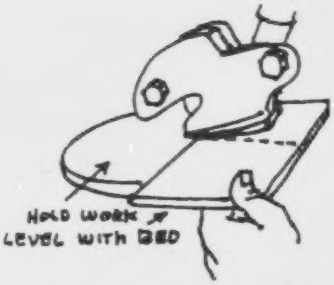
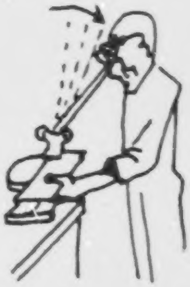
OPERATION SHEET
SC-4-7

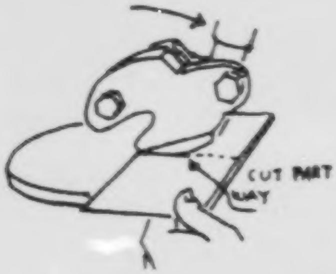
COMPETENCY: Shear Metal on the Bench Lever Shear

COURSE: Sheet Metal UNIT IV: Welding

OBJECTIVE: The student will be able to safely and accurately shear metal on the bench lever shear

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Open the blades by raising the handle with right hand until in a comfortable cutting position. 	
2. Place the metal to be cut between the blades with left hand as shown.  HOLD WORK LEVEL WITH BED 	NOTE: On large sheets (more than one man can handle) a helper or two will be needed to hold the sheets.
3. Hold the metal level with the bed of the shear and at the same time follow through with a downward stroke of the handle.	NOTE: Keep from getting squared off or jagged cuts and edges by closing the blades just short of their full length.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
4. Finishing each cut, just short of the full length of the shears, push the work forward at the same time the blade is raised and the next cut started where the last cut ended.  	
5. Finish the cut.	NOTE: Keep the blades on the line by changing the direction of the sheet being cut.

OPERATION SHEET
SC-4-8

COMPETENCY: Join Metal by Fusion Welding with Oxy-Acetylene Torch

COURSE: Sheet Metal **UNIT IV:** Welding

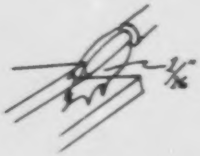
OBJECTIVE: The student will be able to join metal by adding filler rod to puddle

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

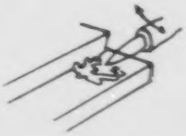
1. Put the metal on a bench covered with fire bricks.

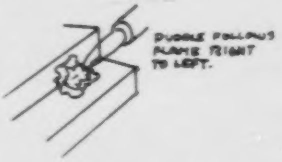
2. Hold the torch at a 45° angle, and, beginning at the right side of the plate, melt the two pieces of metal together--tack weld.



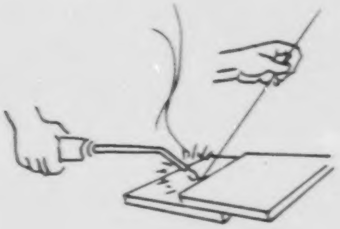
3. Holding the torch at a 45° angle from the direction of travel, melt the edges of the left side--tack weld.

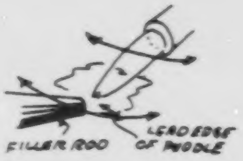
4. Holding the torch at 45°, traveling from right to left, forehand technique, melt the base metal to form a puddle before adding the filler rod.



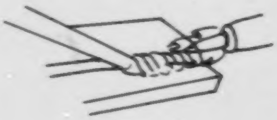


5. Place the filler rod in the leading edge of the puddle at a 45° angle, 1/16" from the cone of the flame.




FILLER ROD
LEAD EDGE OF PUDDLE

6. Moving the puddle right to left, add enough filler to keep the right bead size.



OPERATION SHEET
SC-4-9

COMPETENCY: Use the Portable Disc Sander

COURSE: Sheet Metal UNIT IV: Welding

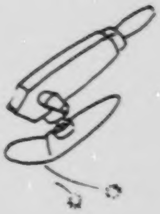
OBJECTIVE: The student will be able to sand with portable sander without excessive wear on the sanding disc and with safety

Page 1 of 2 pages

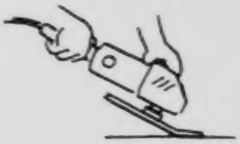
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

Use the grinder for sanding:

1. Hold it so that only the top or bottom 1½" to 2" of the disc will touch the metal.



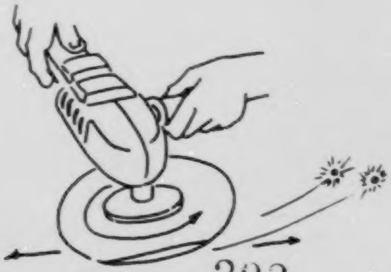
2. Hold the grinder so the side of the disc which is not touching the metal is at a 20° angle to the work.



NOTE: Do not push on the grinder.

3. Move the grinder back and forth.

NOTE: Overlap about half of each stroke. This leaves a criss cross pattern and shows the low spots.



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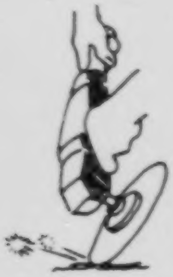
COMPETENCE - PROCEDURE/STEPS

Use the grinder for cleaning:

1. Hold the disc at an 80° angle so the edge of the disc will cut into the low spots and welds to clean them out.



TEACHING/LEARNING ACTIVITIES

NOTE: The disc grinder can be used to clean metal for brazing, soldering, and plastic filling. By tilting the grinder, you can grind sharp, low areas clean. The grinder must be used carefully and correctly or too much metal may be ground away.

OPERATION SHEET
SC-4-10

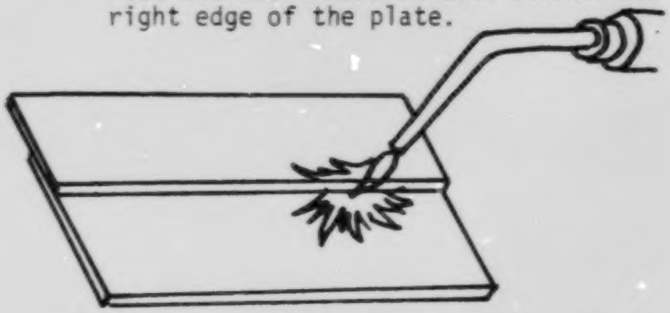
COMPETENCY: Braze with Oxygen and Acetylene Torch

COURSE: Sheet Metal UNIT IV: Welding

OBJECTIVE: The student will be able to join metal by hand soldering with brass rod

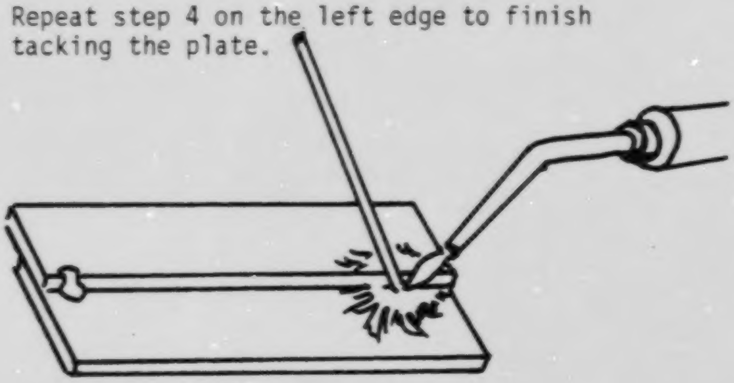
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place the metal on a bench covered with fire bricks.	
2. Heat the end of the brazing rod and dip it into flux.	NOTE: Skip this step if you are using a flux coated rod.
3. Hold the torch at a 45° angle and preheat the base metal to dull red on the right edge of the plate.	



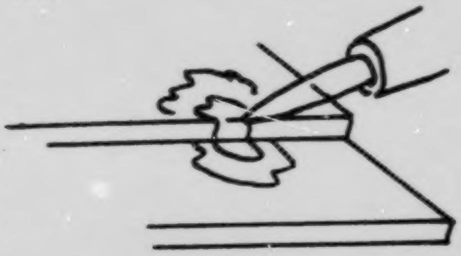
4. Touch the rod to the heated portion and let it melt and react with the base metal--tack weld.

5. Repeat step 4 on the left edge to finish tacking the plate.

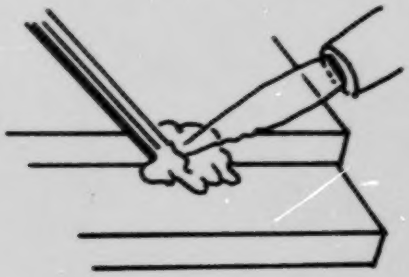


COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES

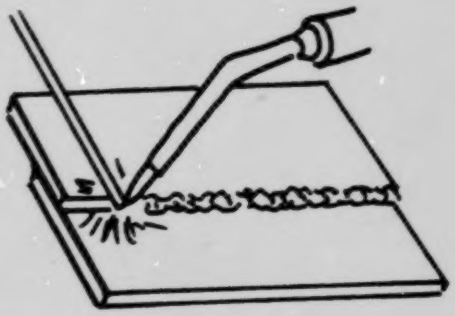
6. Hold the torch at a 45° angle and preheat the right edge of the plate to dull red.



7. Let the rod melt and form a puddle.



8. Add enough rod for the build-up needed and make a bead on the bare metal from right to left.



OPERATION SHEET
SC-4-11

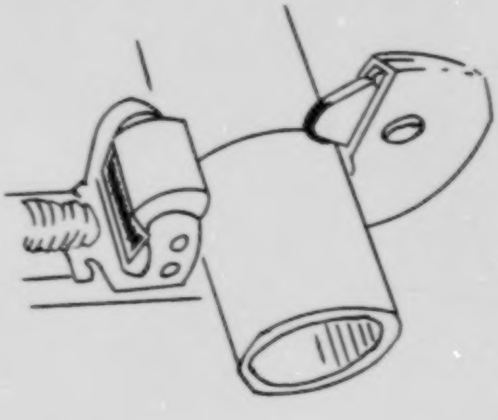
COMPETENCY: Cut Pipe

COURSE: Sheet Metal UNIT IV: Welding

OBJECTIVE: The student will be able to properly cut steel pipe with a hand cutters

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place black steel pipe in vise.	
2. Place cutter on pipe--on mark--cutter opening up.	
3. Tighten the pipe against the cutting wheel for the initial rotating of the cutter.	NOTE: The pipe to be cut fits between the two rollers and cutting wheel.
4. Tighten the handle on the screw ¼ turn by turning clockwise and rotate the cutter counter clockwise around the entire pipe.	CAUTION: Do not tighten the handle too tight as it will crack or dull the cutter wheel.
5. Tighten the handle ¼ turn clockwise after each rotation to cut the groove deeper. Use cutting oil.	CAUTION: On short cut-offs, watch your upper arm so it is not cut on the pipe while rotating the cutter.
6. Cut a deeper groove in the outside surface of the pipe, continually turning the handle--until the cut is through the pipe.	



NOTE: Make sure you have some method of catching the piece that is being cut off.

OPERATION SHEET
SC-4-12

COMPETENCY: Ream a Pipe

COURSE: Sheet Metal

UNIT IV: Welding

OBJECTIVE: The student will be able to ream a pipe to reduce friction and resistance

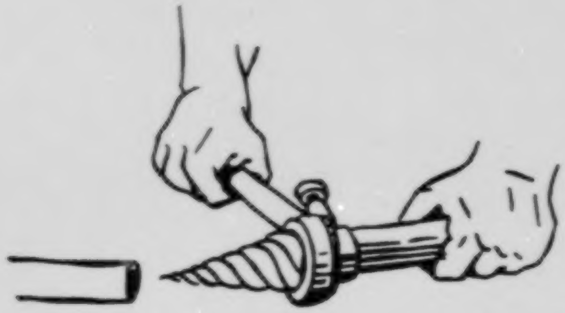
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

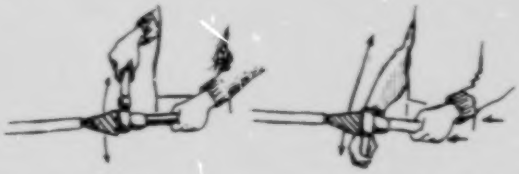
1. Hold the reamer as shown.

2. Place the reamer in the end of the pipe and push in on it with left hand.

3. Push down on the handle of the reamer with right hand.



4. Ratchet the handle up and down until the burrs are removed from the pipe.



5. Keep rotating the reamer while removing it so as not to leave a burr caused by the reamer.

OPERATION SHEET
SC-4-13

COMPETENCY: Thread a Pipe Using Pipe Dies

COURSE: Sheet Metal

UNIT IV: Welding

OBJECTIVE: The student will be able to thread steel pipe with the use of stocks and dies

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

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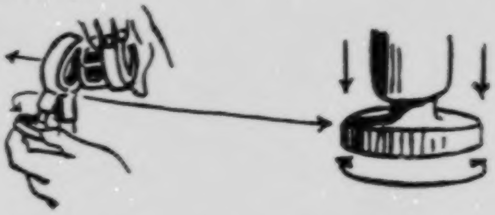
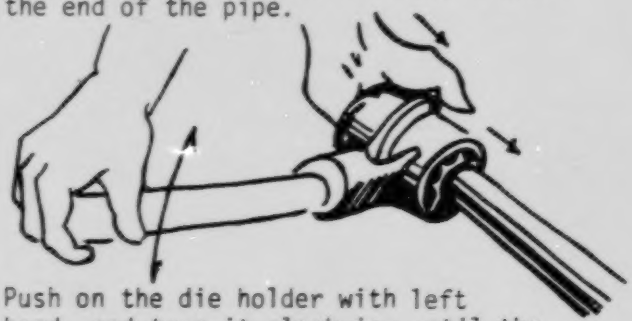
1. Put the pipe to be threaded in a hinged pipe vise with the end sticking out about 6".

2. Put the right size die into the die holder, and set the die for clockwise cutting.

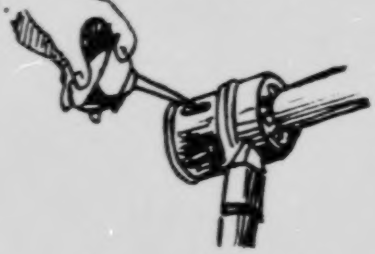


3. Hold the die holder in right hand and slip guide the end of the die over the end of the pipe.



4. Push on the die holder with left hand, and turn it clockwise until the die starts cutting thread.

5. Apply cutting oil to the threading area on every rotation.



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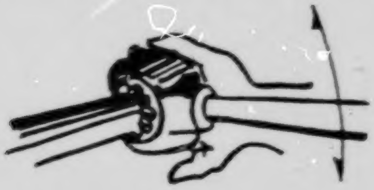
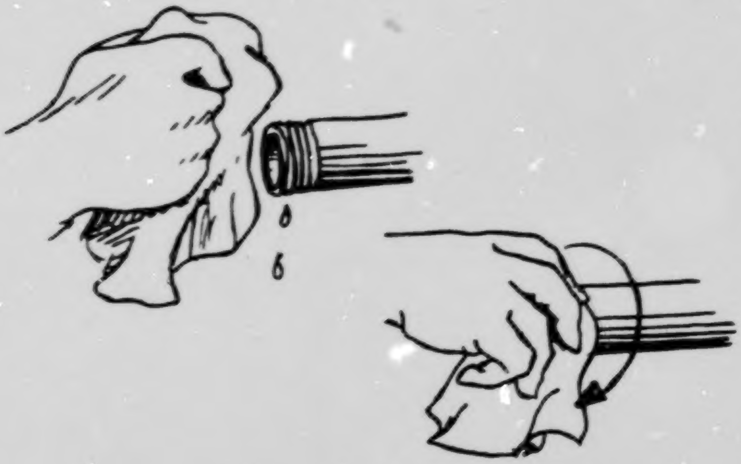
6. Ratchet the die holder in the arc shown.



7. Cut threads until one thread comes through the die.

8. Re-set the die rotation with left hand and back the die off.

9. With the wipe cloth, wipe off the excess cutting oil as shown.



OPERATION SHEET
SC-4-14

COMPETENCY: Attach and Light a Cutting Torch

COURSE: Sheet Metal

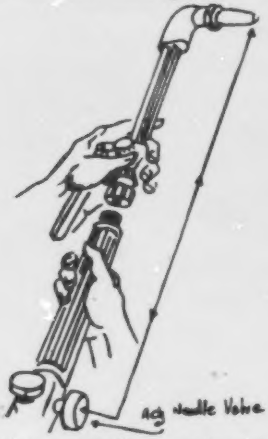
UNIT IV: Welding

OBJECTIVE: The student will be able to attach cutting head and light and adjust torch in preparation for flame cutting

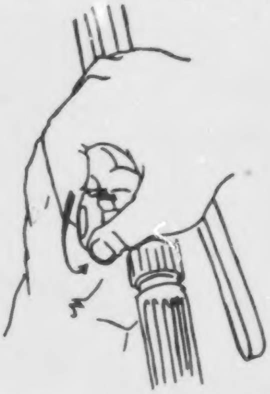
Page 1 of 3 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

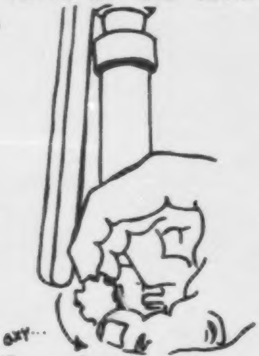
1. Hold the torch in right hand and the cutting attachment in left hand.
2. Seat the cutting attachment and line the top up with the acetylene needle valve.



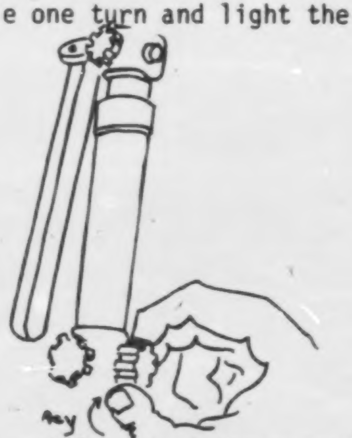
3. Tighten the cutting attachment nut to the torch body hand tight.



4. Turn the oxygen needle valve on the torch handle completely open.

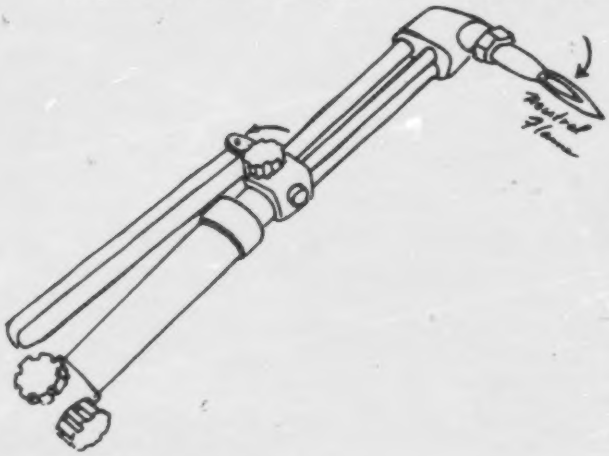


5. Open the acetylene needle valve on the torch handle one turn and light the torch.

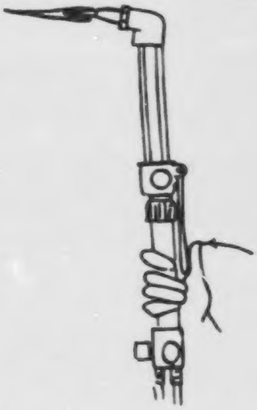


6. Adjust the acetylene to between smoke and blow off.

7. Open the needle valve on the cutting attachment and adjust to neutral flame.



8. Press the cutting lever fully and readjust the flame to neutral if necessary.



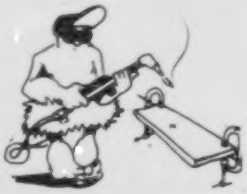
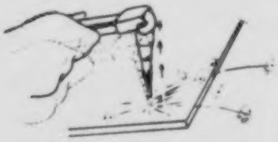
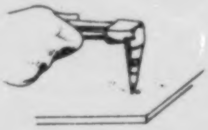
OPERATION SHEET
SC-4-15

COMPETENCY: Pierce Holes with a Cutting Torch

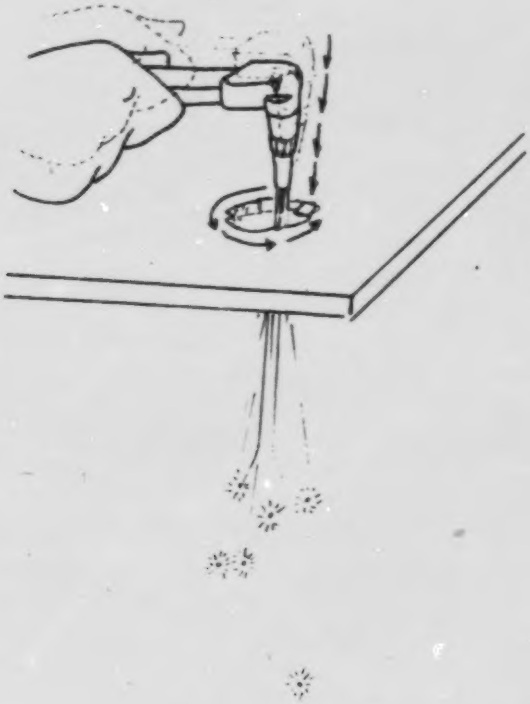
COURSE: Sheet Metal **UNIT IV:** Welding

OBJECTIVE: The student will be able to use a cutting torch to pierce holes in steel

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the tip about ¼" above the work surface. 	
2. Start to raise the tip (½" to 1" above the work) and at the same time, slowly press the cutting oxygen lever all the way. 	NOTE: Tilt the tip slightly so that the oxides blow away from you and do not blow right back at the tip.
3. Hold the tip steady until a hole is pierced in the metal. 	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
4. Lower the tip to normal height and make sure it is square with the work.	NOTE: Rotate the tip to make the hole as large as wanted.



OPERATION SHEET
SC-4-15A

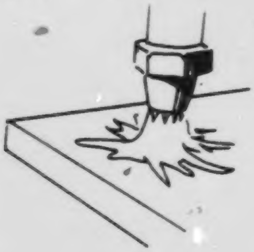
COMPETENCY: Flamecut with a Hand Torch

COURSE: Sheet Metal

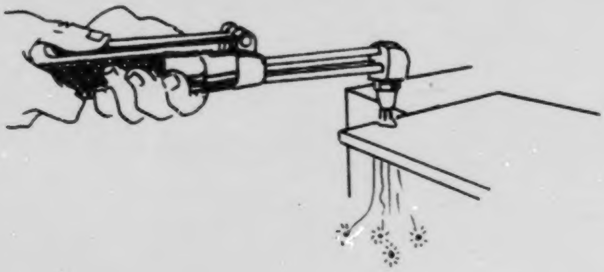
UNIT IV: Welding

OBJECTIVE: The student will be able to use the torch to flame cut steel

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place the metal to be cut so there is room for spark shower clearance under it.	
2. With the torch adjusted to neutral flame, hold the torch handle firmly with right hand.	NOTE: Start the cut at the edge of the plate when you can.
3. Hold the torch tip vertical to the metal.	
4. Hold the inner cone 1/16" above the surface to be cut. 	
5. Keep the torch in this position until the metal turns bright red.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
6. Slowly press the oxygen cutting lever and move the torch along the cutting line.	



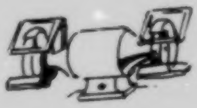
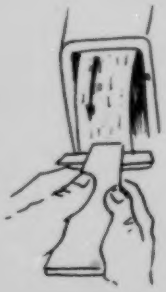
OPERATION SHEET
SC-4-16

COMPETENCY: Grind Metal on Bench Grinder

COURSE: Sheet Metal UNIT IV: Welding

OBJECTIVE: The student will be able to use bench grinder to sharpen tools and grind metal

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Adjust tool rest. 2. Check wheel for nicks, and proper dressing.	
3. Adjust face shield. 4. Stand to side of wheel and turn on grinder. 5. Hold stock firmly against tool rest as shown.	
6. Apply enough pressure to grind the metal and continue applying pressure while moving job back and forth across wheel face until desired shape is attained. 7. Remove metal from tool rest and turn off machine.	

OPERATION SHEET
SC-4-17

COMPETENCY: Strike an Arc and Run a Bead

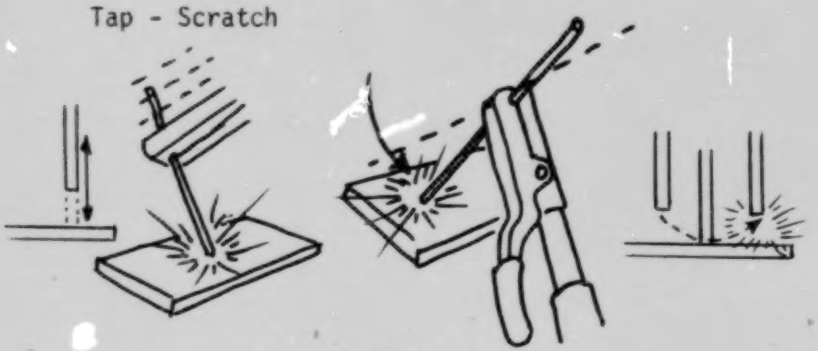
COURSE: Sheet Metal UNIT IV: Welding

OBJECTIVE: The student will be able to run smooth, even, properly formed beads with electric welder

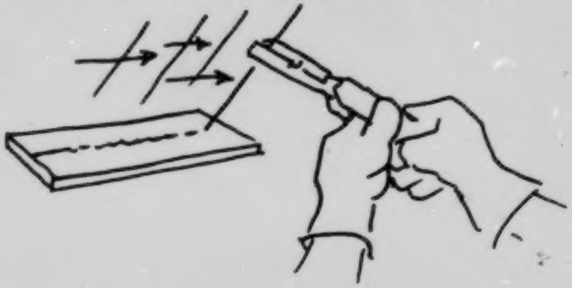
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Establish the arc on the plane according to method shown:	NOTE: Listen for the arc sound (frying sound).

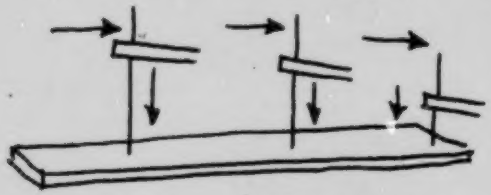
Tap - Scratch



2. Maintain the arc length and begin to move electrode from left to right.



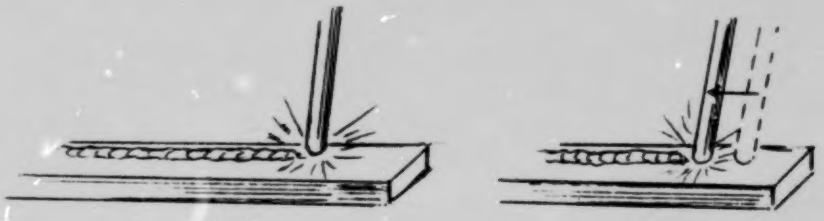
3. Progress along the plane continually lowering rod into puddle as it is consumed.



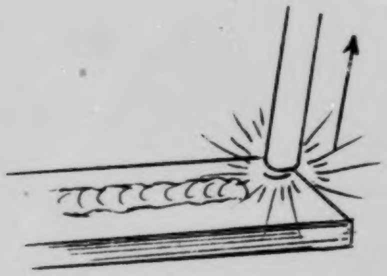
4. Lift rod to stop weld, (break the arc).

COMPETENCE - PROCEDURE/STEPS | TEACHING/LEARNING ACTIVITIES

5. Re-start the arc by striking arc ahead of puddle (about 1"), maintaining a long arc to develop heat needed and moving into puddle, then continue on with weld.



6. When weld is completed reverse direction of weld slightly to fill crater - or lift rod slowly allowing crater to fill.



OPERATION SHEET
SC-4-18

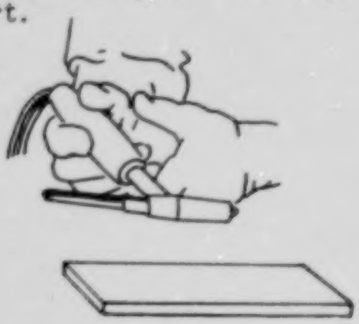
COMPETENCY: Strike an Arc and Run a Fusion Bead with T.I.G. Welder

COURSE: Sheet Metal UNIT IV: Welding

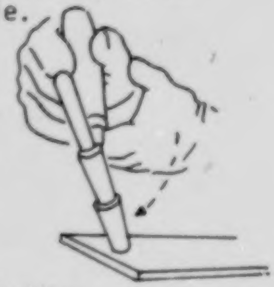
OBJECTIVE: The student will be able to accurately and uniformly run a bead with the T.I.G. welder

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Establish the arc by holding torch in horizontal position 2" above work piece as shown, and then swing down for high frequency start.	



2. Maintain an arc length of approximately one electrode diameter and begin to move torch from right to left holding torch at approximately 75° angle.	



3. Progress along the joint adding filler rod in jabs as necessary.	NOTE: Maintain crater depth and size so bead will remain uniform.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
4. Release foot pedal or thumb control to extinguish arc.	
5. Restart the arc by striking arc ahead of puddle (about 1"), maintaining a long arc to develop heat needed and move back into puddle, then continue on with weld.	
6. When weld is completed fill crater by reversing direction slightly and filling crater with metal.	

OPERATION SHEET
SC-4-19

COMPETENCY: Assemble by Fusion Welding with the M.I.G. Welder

COURSE: Sheet Metal UNIT IV: Welding

OBJECTIVE: The student will be able to properly run neat uniform beads with the M.I.G. welder

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Establish arc by either the running start method or scratch start method by pushing trigger until wire is lit.

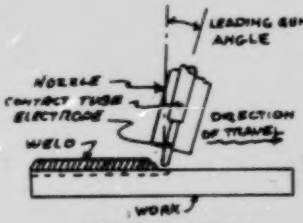
2. Once the arc is established, hold the gun at the correct angle shown below and hold the trigger continuously.

3. Progress along the joint in either a pulling or pushing method, maintaining the correct crater depth and size to keep the bead uniform.

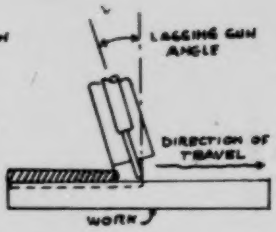
4. Restart, by starting the arc 1" ahead of crater and back into crater, then proceeding as before.

5. Fill crater by backing up slightly into crater at end of weld.

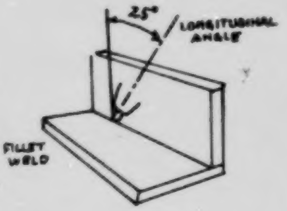
6. When weld is completed, release trigger but allow gun to cover weld crater until cool, to allow the gas to protect the weld from contamination.

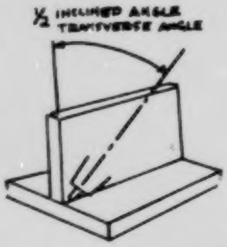

LEADING GUN ANGLE
NOZZLE
CONTACT TUBE
ELECTRODE
WELD
DIRECTION OF TRAVEL
WORK

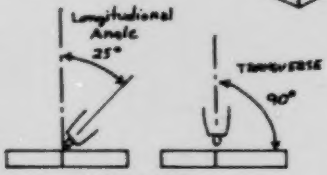
LEADING GUN ANGLE


LAGGING GUN ANGLE
DIRECTION OF TRAVEL
WORK

LAGGING GUN ANGLE


25°
LONGITUDINAL ANGLE
FILLET WELD


½ INCLINED ANGLE
TRANSVERSE ANGLE


Longitudional Angle
25°
TRANSVERSE
90°

Butt Welds

OPERATION SHEET
SC-5-1

COMPETENCY: Form a Pittsburgh Lock in the Brake

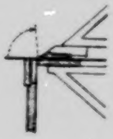
COURSE: Sheet Metal **UNIT V:** Duct Fittings

OBJECTIVE: The student will be able to use the brake to properly form a pittsburgh lock

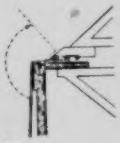
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

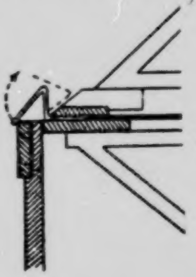
1. Insert the sheet in the brake, close the upper jaw flush with the prick punch marks and raise the bending leaf until the sheet is formed slightly less than a 90° angle.



2. Insert the formed edge (small end of job) in the brake, holding the sheet against the bending leaf and raising the bending leaf as far as possible.



3. Insert the sheet in the brake, hold the 90° bend against the edge of the upper jaw, close the upper jaw and raise the bending leaf as far as possible.



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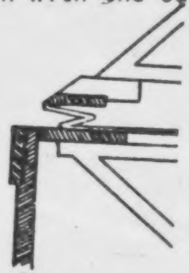
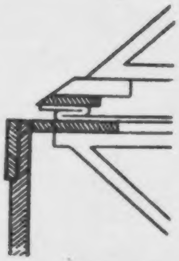
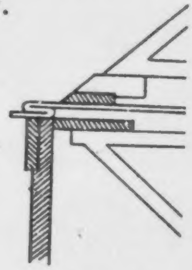
4. Insert the sheet in the brake with the upper edge flush with the outer edge of the upper jaw.



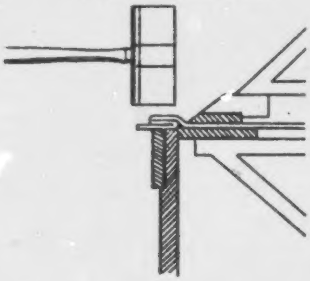
5. Close the upper jaw.

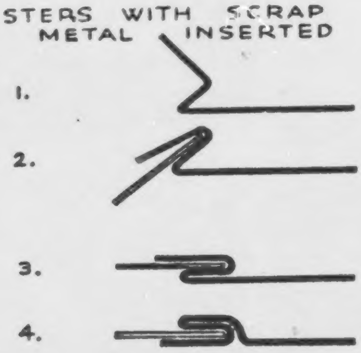


6. Turn the sheet over, insert the sheet in the brake with the outer bent edge flush with the outer edge of the bending leaf and close the upper jaw.



7. Raise the bending leaf slightly and offset the pocket by striking the outer edge with a mallet.





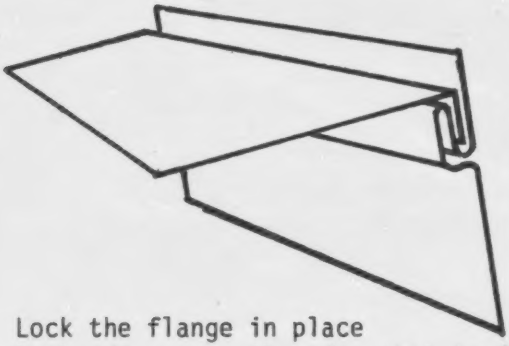
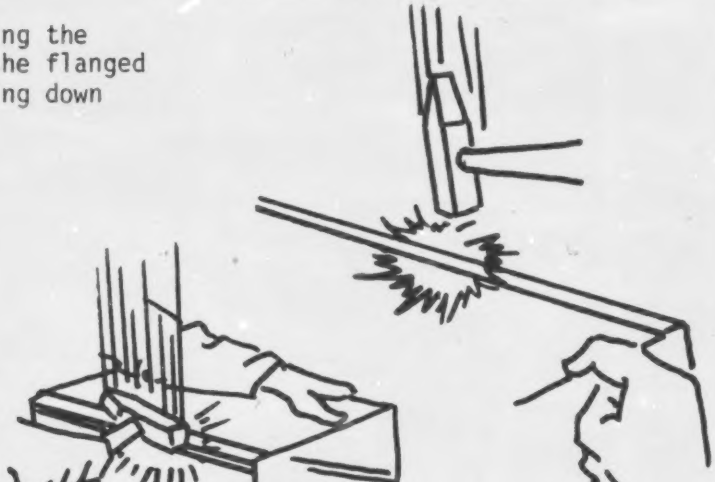
OPERATION SHEET
SC-5-2

COMPETENCY: Assemble a Pittsburgh Lock

COURSE: Sheet Metal **UNIT V:** Duct Fittings

OBJECTIVE: The student will be able to learn the correct way to assemble the pittsburgh lock

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Start at one end of the job and place the flanged edge into the pocket. 	NOTE: Clamp one end in place with vise grips, complete job, release grips.
2. Lock the flange in place by bending over the edge that is free with a setting down hammer.	
3. Keep working the flange into the pocket with the lock set and setting down hammer until the whole lock is together.	NOTE: On large jobs, you may have to lock the seam from time to time to keep the flange from coming out of the pocket.
4. Finish forming the lock by setting the lip of the pocket tightly over the flanged edge using the side of the setting down hammer.	

OPERATION SHEET
SC-5-3

COMPETENCY: Form a Pittsburgh Lock on a Lock Former

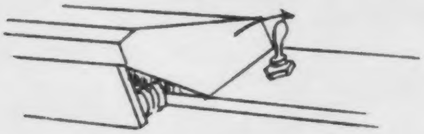
COURSE: Sheet Metal UNIT V: Duct Fittings

OBJECTIVE: The student will be able to learn to use the pittsburgh lock former

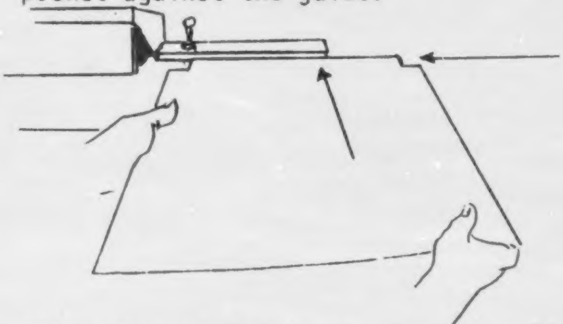
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

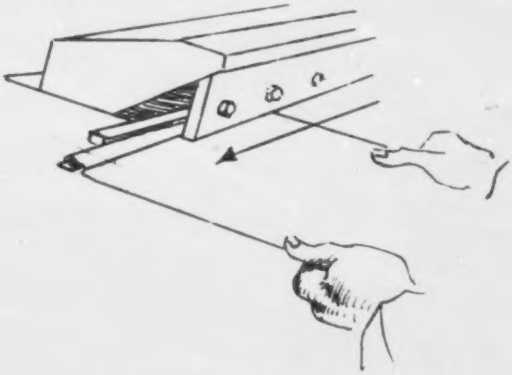
1. Turn on the lock former switch.



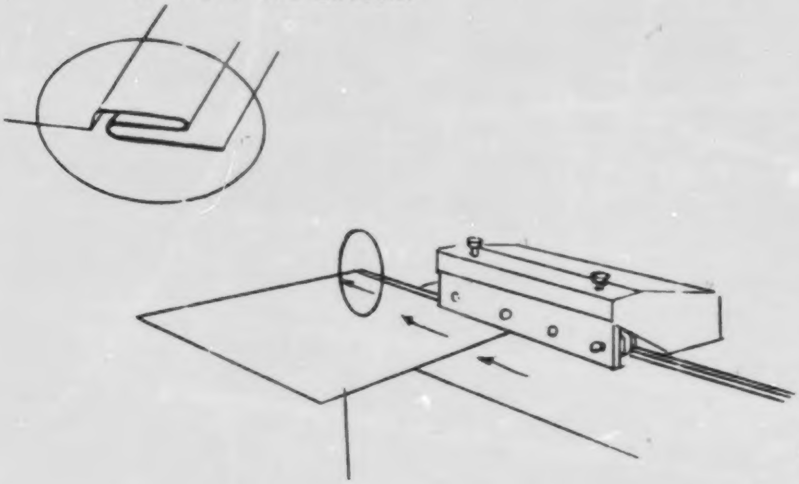
2. Put the edge to be made into the lock pocket against the guide.



3. Slide the metal into the forming rolls making sure that the metal stays against the guides at all times.



4. Remove the metal from the lock former and turn off the switch.



OPERATION SHEET
SC-5-4

COMPETENCY: Form Cleats on the Cleat Bender

COURSE: Sheet Metal

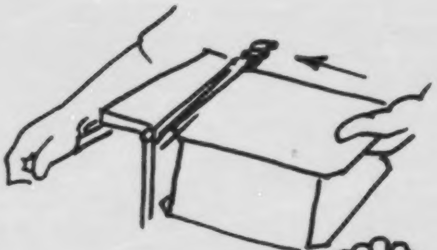
UNIT V: Duct Fittings

OBJECTIVE: The student will be able to properly form cleats on the cleat bender

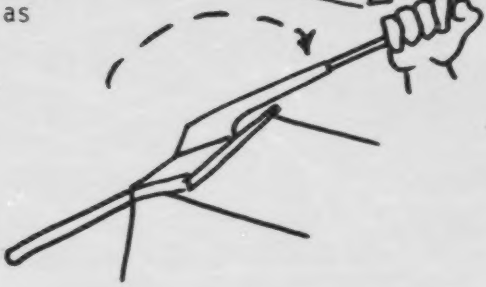
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

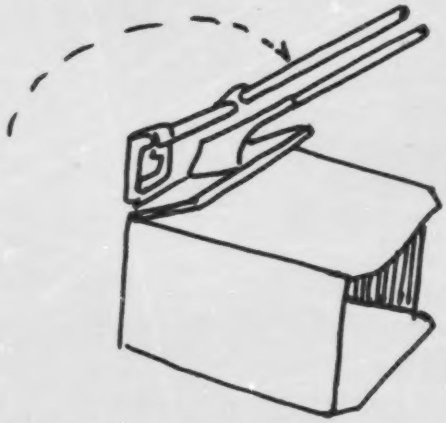
1. Select the proper width on machine to fit size of duct edge to be turned.



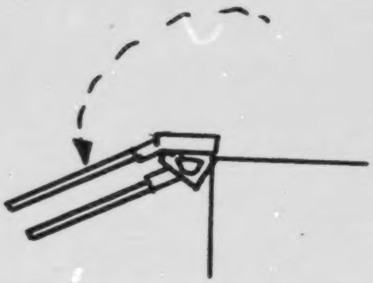
2. Put duct all the way into the bender and bring up first handle as far as it will go.



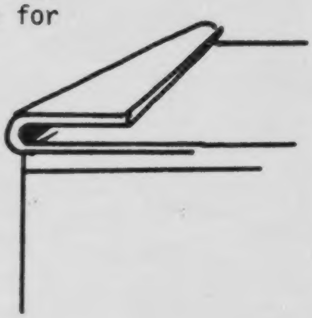
3. Release the second handle - bring up to meet the first handle.



4. Tilt both handles back till duct is released from the bender and pull the duct from the machine.



5. Slide the duct back into the machine and bring first handle forward to close the drive edge leaving enough space for the drive to slide on the edge.



OPERATION SHEET
SC-5-5

COMPETENCY: Make "S" Cleats

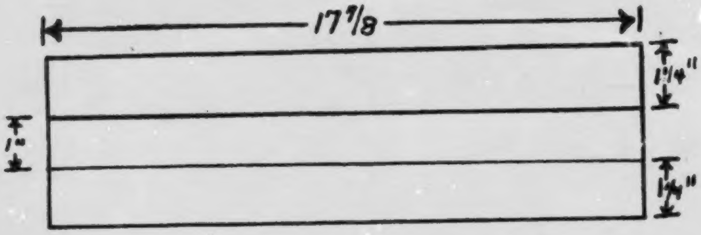
COURSE: Sheet Metal UNIT V: Duct Fittings

OBJECTIVE: The student will be able to make "S" cleats to join rectangular duct

Page 1 of 1 page

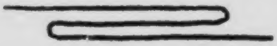
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Lay out a strip of steel 1/8" shorter than width of duct.



2. Mark across strip 1-1/4" - 1" - 1-1/4" for a total width of 3-1/2".

3. Bend the two marks in opposite directions 180° to complete "S" slip.



OPERATION SHEET
SC-5-6

COMPETENCY: Make Drive Cleats

COURSE: Sheet Metal

UNIT V: Duct Fittings

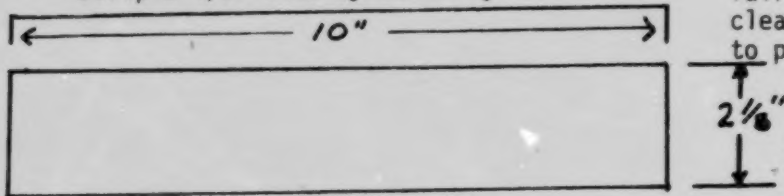
OBJECTIVE: The student will be able to make a series of uniform cleats through the proper practice of cutting and bending

Page 1 of 1 page

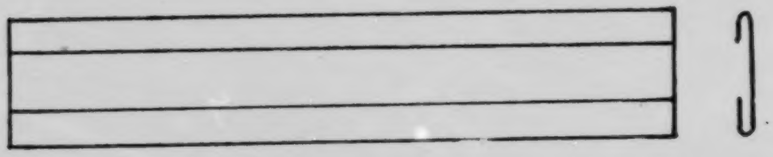
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. For an 8" drive cleat, lay out a metal strip 2 1/8" wide by 10" long.

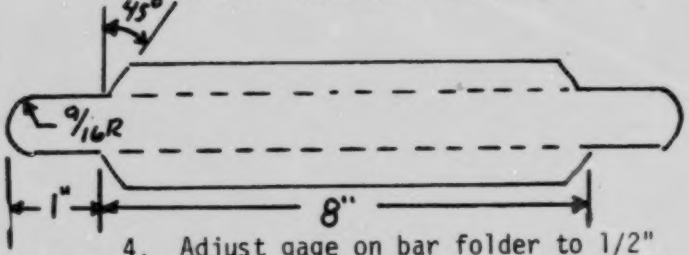
NOTE: Material should be fairly heavy (22 gage) because cleats must be sturdy enough to permit driving onto duct with a hammer.



2. Put a bend line 1/2" in from each side.

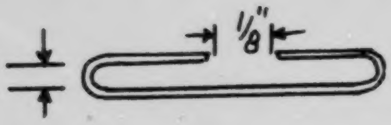


3. Notch out a 1 x 1/2" piece at each corner and round remaining ends.



4. Adjust gage on bar folder to 1/2" fold both edges 180° pressing edges down but not too tightly.

NOTE: Check to be sure space between edges is approximately 1/8".



OPERATION SHEET
SC-5-7

COMPETENCY: Assemble a Duct with "S" and Drive Clips

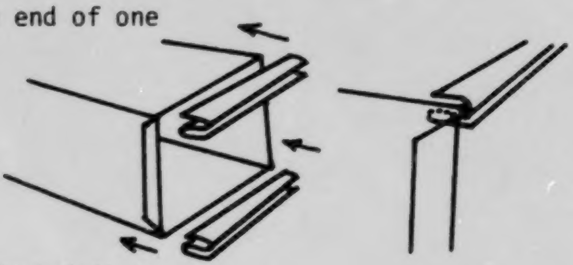
COURSE: Sheet Metal UNIT V: Duct Fittings

OBJECTIVE: The student will be able to properly assemble a duct using "S" and drive clips

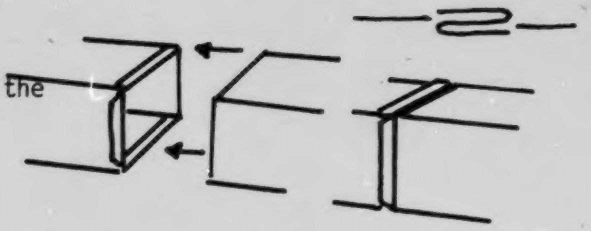
Page 1 of 1 page

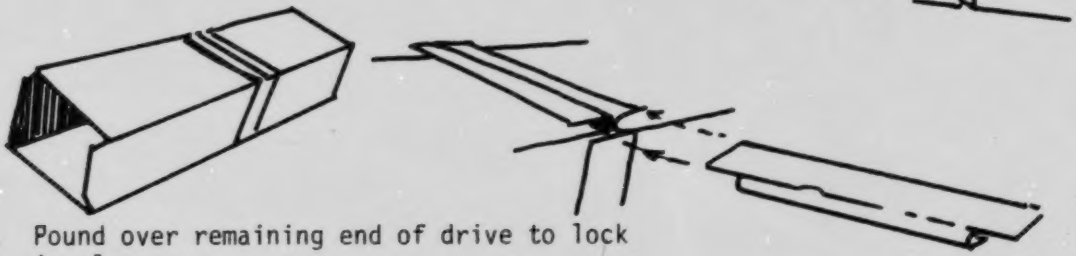
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Slide the "S" clips on to the end of one duct.

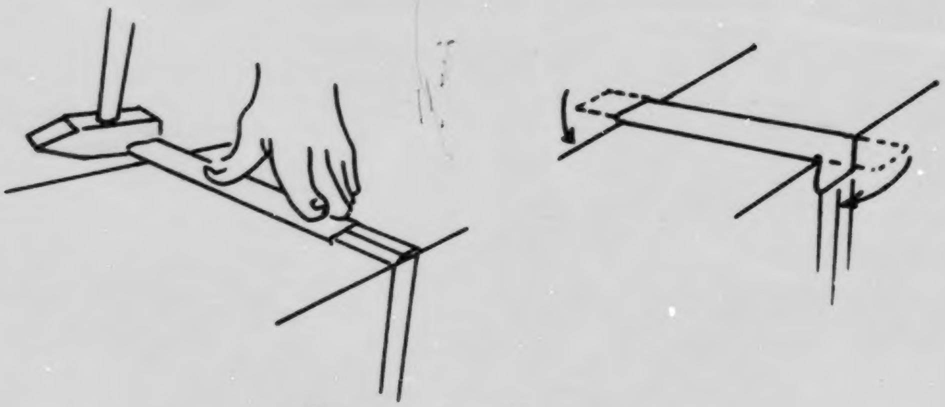


2. Slide one end of the second duct into the "S" clip.
3. Connect the drives by bending 1/2" on the clips and slide over the bent ends of the duct.





4. Pound over remaining end of drive to lock in place.



OPERATION SHEET
SC-5-8

COMPETENCY: Form Metal on a Crossbrake

COURSE: Sheet Metal

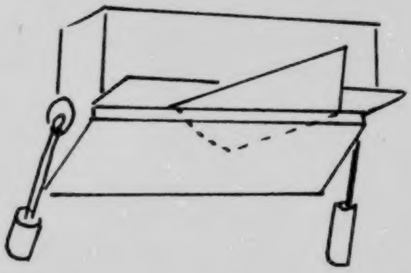
UNIT IV: Duct Fittings

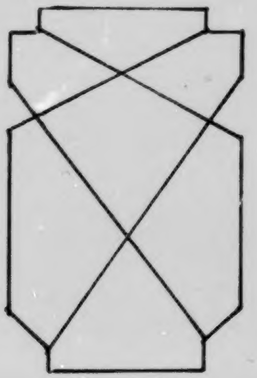
OBJECTIVE: The student will be able to form a stiffening bend on metal

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Place metal in brake as shown
2. Pull up on bending leaf handle until slight bend is formed.
3. Release brake and rotate job to align new crossbrake marks.
4. Form other half of bend as in step 2.
5. Release pull-down handle and remove job.





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OPERATION SHEET
SC-5-9

COMPETENCY: Form a Flange on the Easy Edger

COURSE: Sheet Metal

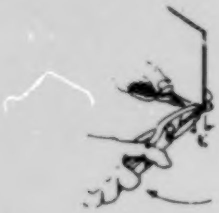
UNIT V: Duct Fittings

OBJECTIVE: The student will be able to properly flange on the easy edger making a smooth curved edge

Page 1 of 2 pages

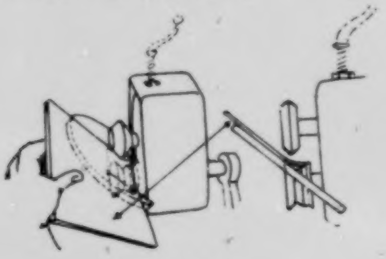
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. With the combination pliers, bend a 90° flange as wide as the plier jaws and 3/16" deep.

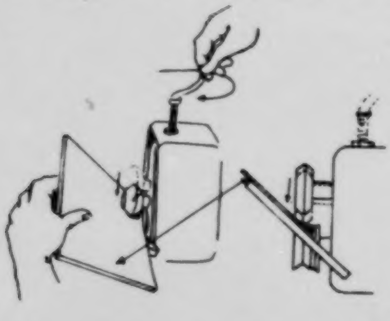


2. Put the flange edge between the rolls on the easy edger with the flange up.

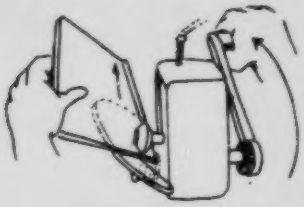
3. Put the corner of the flange in the guide groove of the lower roll.



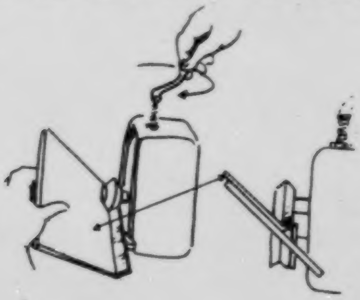
4. Turn the crankscrew handle and bring the upper roll down until tight then release ¼ turn.



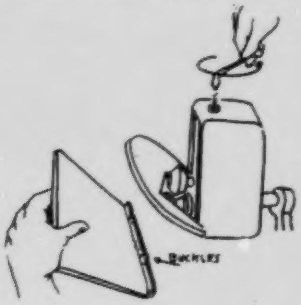
5. Making sure the job rests on the main guide lip, turn the operating handle until the flange is formed.



6. Release the crankscrew and remove the job.



7. Re-run the job to remove all the buckles and then remove the job from the easy edger.



OPERATION SHEET
SC-5-10

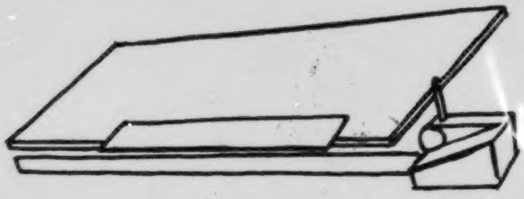
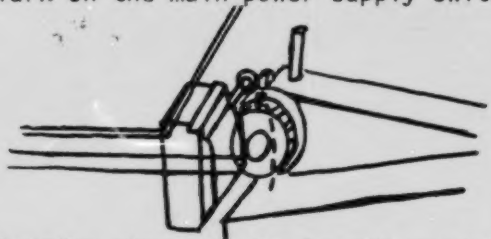
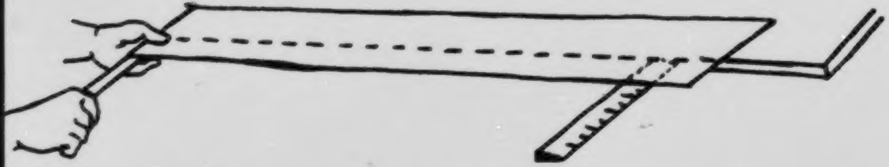
COMPETENCY: Cut Metal on the Shop Master Unit

COURSE: Sheet Metal

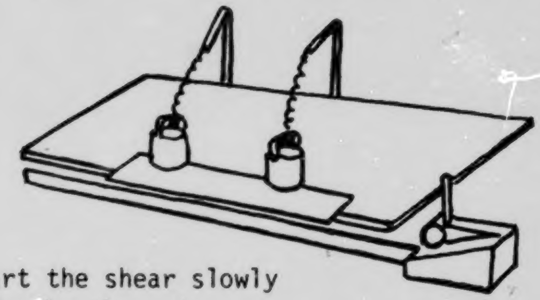
UNIT V: Duct Fittings

OBJECTIVE: The student will be able to properly operate and cut metal on the shop master unit

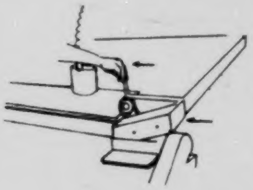
Page 1 of 2 pages

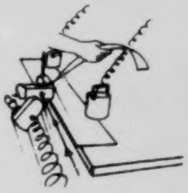
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place the sheet to be cut on the bench. 	CAUTION: Be sure the magnets are turned off.
2. Turn on the main power supply switch. 	
3. Set the sheet to the length or width wanted. 	NOTE: Allow 1/16" overhang for the cut.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
4. Set the electromagnet as shown.	NOTE: Allow room for the shear to pass the magnets.

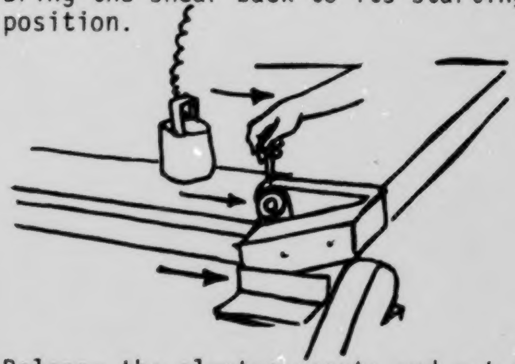


5. Start the shear slowly and make the cut.





6. Bring the shear back to its starting position.



7. Release the electromagnets and cut the main power.

OPERATION SHEET
SC-5-11

COMPETENCY: Notch Metal on the Power Notching Unit

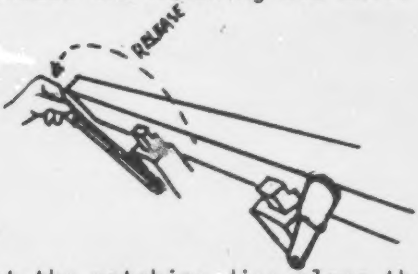
COURSE: Sheet Metal **UNIT V:** Duct Fittings

OBJECTIVE: The student will be able to accurately notch metal on the power notching unit

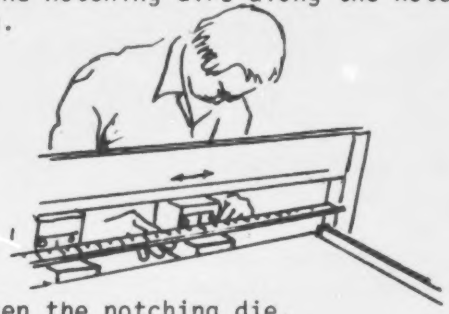
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

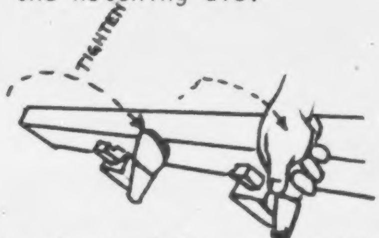
1. Release the notching die unit.



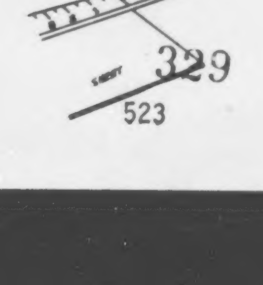
2. Set the notching dies along the notching scale.



3. Tighten the notching die.

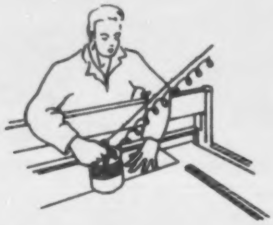


4. Slide the sheet tight against the depth gage and line up the end of the sheet with "0" on the scale.



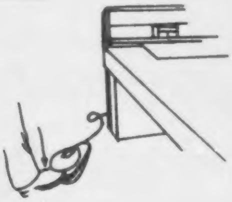
COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES

5. Set the electromagnets to hold the sheet.



6. Turn on the power to the notching unit.

7. Make the notch by quickly pressing on the foot switch.



8. Turn off the electromagnets and take the piece out.

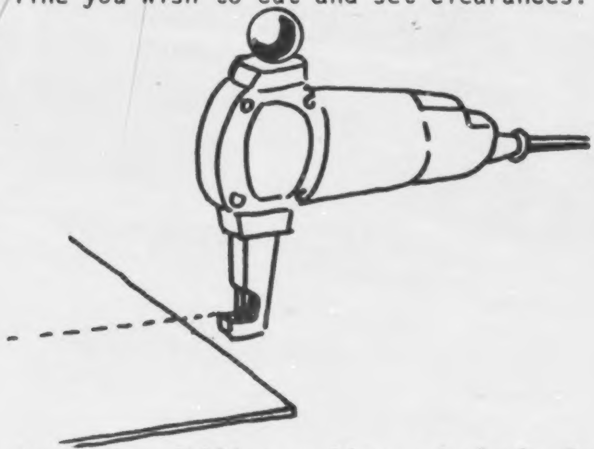
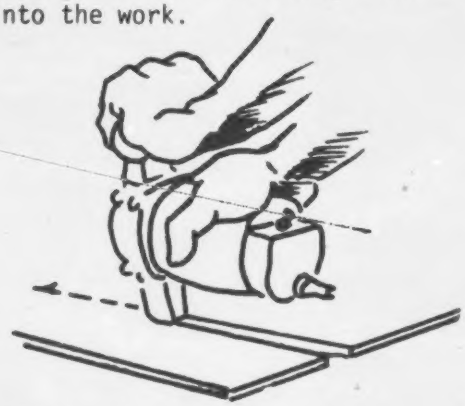
OPERATION SHEET
SC-5-12

COMPETENCY: Cut with Hand Nibbler

COURSE: Sheet Metal **UNIT V:** Duct Fittings

OBJECTIVE: The student will be able to gain a first hand feeling of using the electric nibbler and become familiar with cutting heavy gage material with the nibbling machine

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Place the metal preferably between two tables or over the edge of one table.	NOTE: Nibbling sheet metal of thicknesses from 1/16" to 1/8" are many times best accomplished by using a heavy duty electric hand (or portable) nibbler since it eliminates the necessity of trying to clear one of the cut portions (either up or down).
2. Place the cutters of the nibbler on the line you wish to cut and set clearances. 	NOTE: If the nibbler is fairly heavy let the sheet of metal carry most of the weight.
3. Start the nibbling machine and slowly feed the machine into the work. 	
4. Feed so the nibbler takes the correct amount of cut.	NOTE: Do not try to go too fast.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
5. Keep a constant eye on the cutting line and avoid cutting on and off the marks.	NOTE: Cut or nibbled edges should be fairly smooth and free of sharp or ragged burrs.
6.	

OPERATION SHEET
SC-5-13

COMPETENCY: Cut a Starting Slit for an Inside Cut with Hammer and Chisel

COURSE: Sheet Metal

UNIT V: Duct Fittings

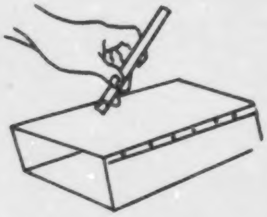
OBJECTIVE: The student will be able to become aquainted with the proper way of holding the chisel and the proper way of striking the chisel

Page 1 of 1 page

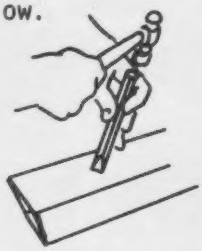
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Place the metal to be slit across an opening in a vise or the edge of the table.

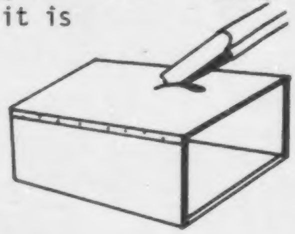
2. Hold the chisel with the cutting edge against the point to be slit.



3. Hold the hammer near the end of its handle and strike the head of the chisel a quick, sharp blow.



4. Keep on slitting the metal until the proper sized slit is obtained.



OPERATION SHEET
SC-5-14

COMPETENCY: Assemble a Tap Lock into a Duct

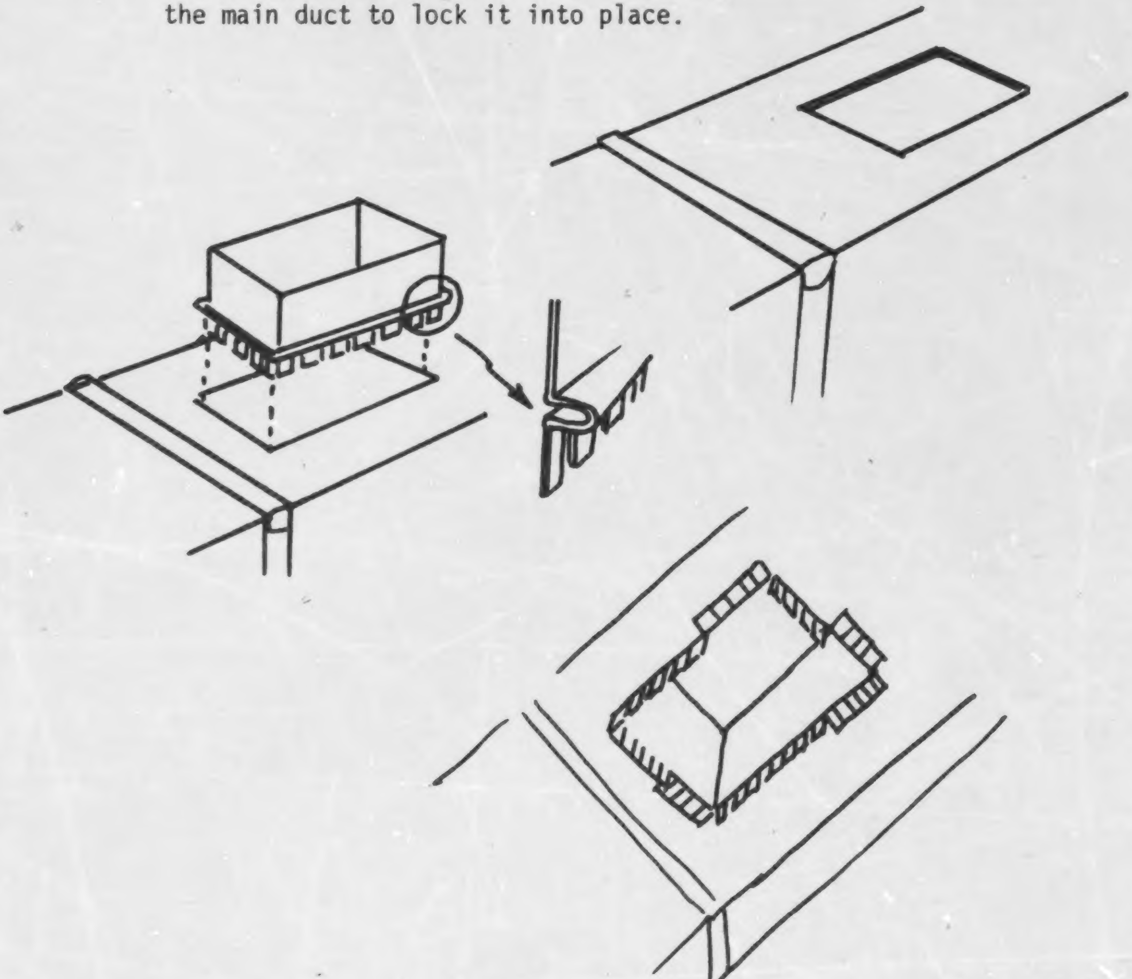
COURSE: Sheet Metal

UNIT V: Duct Fittings

OBJECTIVE: The student will be able to properly assemble a tap lock into a duct

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Lay out the hole to be cut into the duct.	
2. Cut out hole within half of the scribed line and trim to proper size.	
3. Insert the tail of the tap into the hole and knock it over against the inside of the main duct to lock it into place.	



OPERATION SHEET
SC-5-15

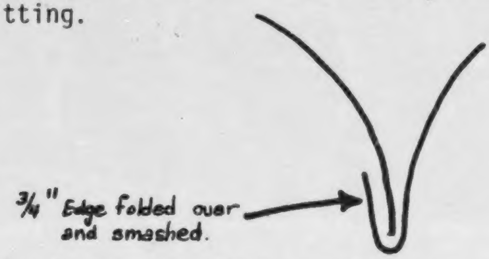
COMPETENCY: Assemble a Hooked Edge

COURSE: Sheet Metal UNIT V: Duct Fittings

OBJECTIVE: The student will be able to neatly and securely assemble a hooked edge

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Bend out square a 3/4" or 7/8" flange on one fitting.	

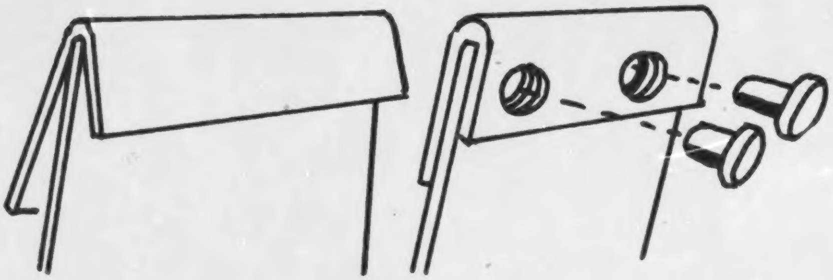


2. Place hand tongs on flange and bend flange around raw edge of other fitting and flatten with hand tongs.

3. Place vise grips over edge to prevent hook from slipping out.

4. Drill and fasten together with pop rivets.

NOTE: Any alternate method can be used such as steel rivets, bolts, screw, etc.



OPERATION SHEET
SC-6-1

COMPETENCY: Cut with a Star Chisel

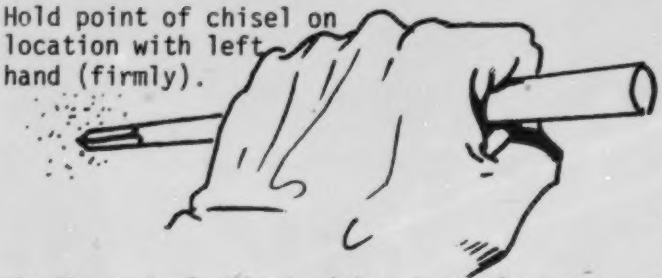
COURSE: Sheet Metal **UNIT VI:** Installation

OBJECTIVE: The student will be able to drill holes safely and quickly with star chisel

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

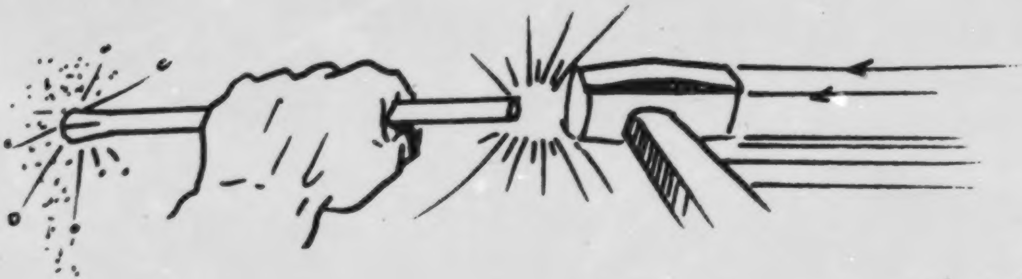
1. Hold point of chisel on location with left hand (firmly).



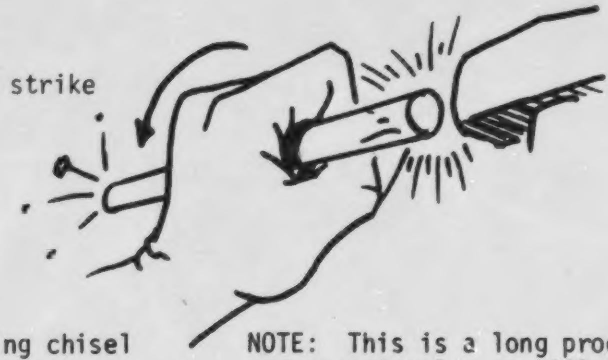
NOTE: The drill should always be held on the exact angle the hole is to go.

CAUTION: Make sure all tools are in a good, safe condition and wear gloves and safety glasses.

2. Strike end of chisel with a heavy hammer.

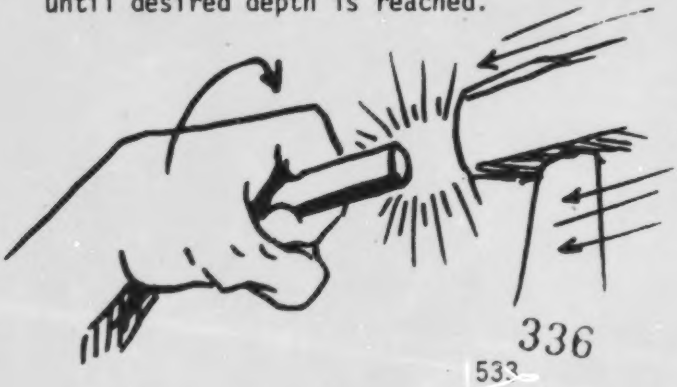


3. Rotate chisel 1 1/4 turn and strike again.



4. Continue hammering and rotating chisel until desired depth is reached.

NOTE: This is a long process and occasional rest will be needed.



OPERATION SHEET
SC-6-2

COMPETENCY: Using the Hammer Drill

COURSE: Sheet Metal

UNIT VI: Installation

OBJECTIVE: The student will be able to learn the proper procedures in drilling and hammering with hammer drill

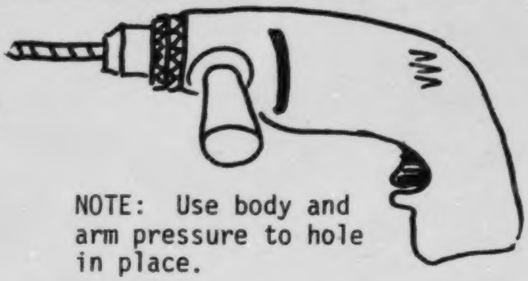
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

---

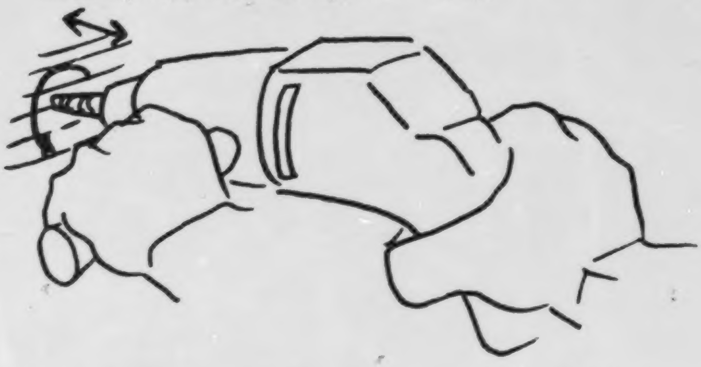
1. Select proper size carbide tipped drill and place into chuck of electric drill.



2. Take hammer and hand star drill and mark location of the hole center.
3. Place the electric drill into position.

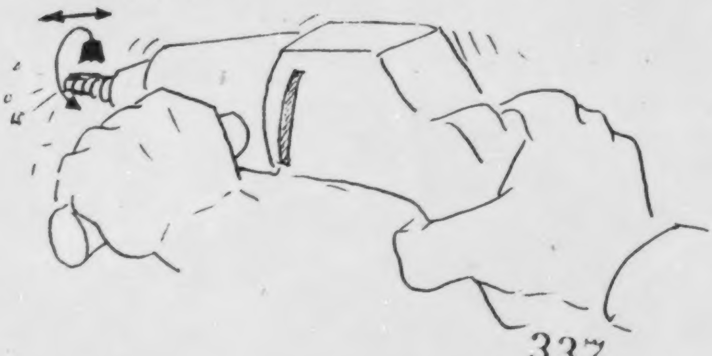
NOTE: Use body and arm pressure to hole in place.

4. Push selector button to drill only.
5. Engage "on" switch and drill hole in masonry approximately 1/2" deep.



6. Push selector button to hammer and drill.
7. Maintain a strong steady pressure on the drill until desired depth of hole is reached.

NOTE: If several holes are to be drilled, set the depth gage so all holes will be drilled the same depth.



OPERATION SHEET
SC-6-3

COMPETENCY: Cut with the Mortar Saw

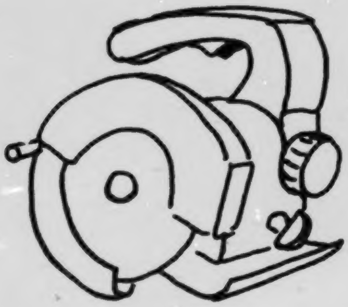
COURSE: Sheet Metal

UNIT VI: Installation

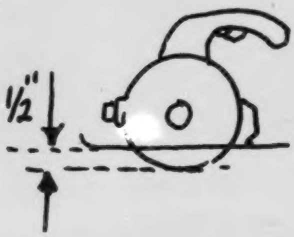
OBJECTIVE: The student will be able to learn how to use the mortar saw safely and efficiently

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Check the carborundum blade to be certain it has been inserted into the power saw correctly.	NOTE: Make certain if in a confined area safety glasses and a face mask are worn.

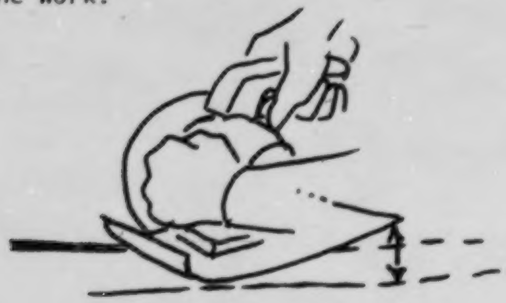


2. Set the guide plate so the blade extends 1/2" below bottom surface.

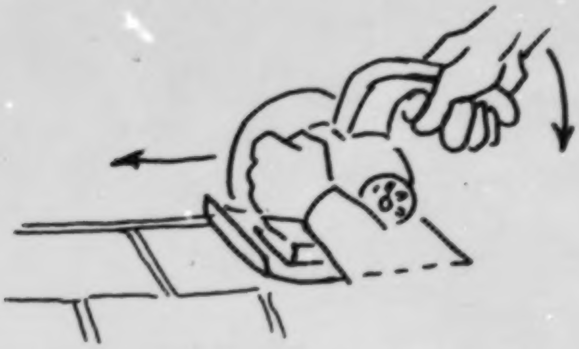


3. Place the saw on the surface to be cut.	NOTE: Hold the saw firmly with both hands.

4. Tip the saw so the handle or portion of saw nearest body is up off the work.



5. Turn on the saw and slowly lower raised end until depth guide is flat on work.



6. With a slow steady speed feed the cutter through the entire joint.

OPERATION SHEET
SC-6-4

COMPETENCY: Fold Metal with Hand Tongs

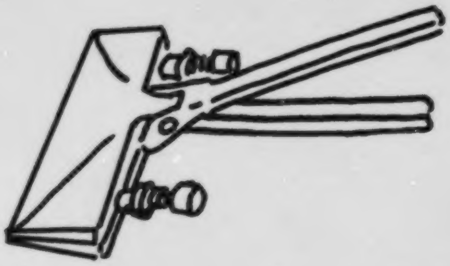
COURSE: Sheet Metal

UNIT VI: Installation

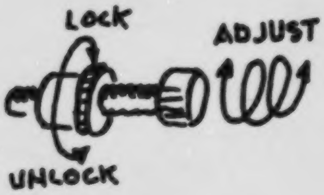
OBJECTIVE: The student will be able to neatly and efficiently fold metal with the hand tongs

Page 1 of 2 pages

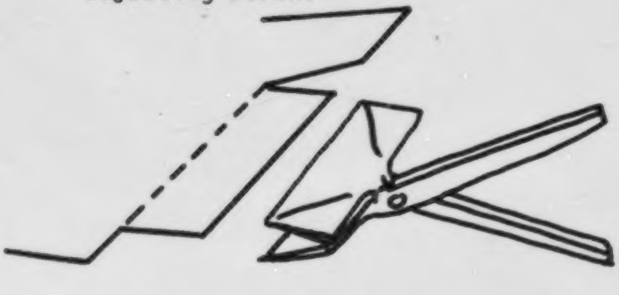
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Turn adjusting screws to the width to be bent.	NOTE: Some hand tongs do not have adjusting screws.



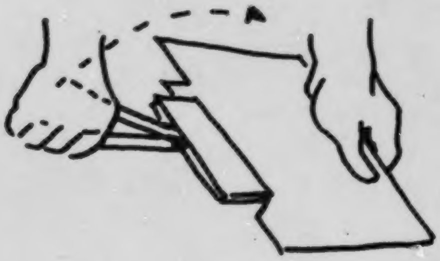
2. Lock thumb screws to keep the correct setting.

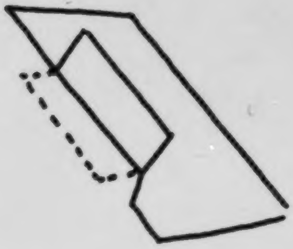


3. Open hand tongs and place material between blades till metal stops at adjusting screw.



4. Holding hands firmly so metal cannot slide out, bend edges of metal to desired angle.





OPERATION SHEET
SC-6-5

COMPETENCY: Use a Caulking Gun

COURSE: Sheet Metal

UNIT VI: Installation

OBJECTIVE: The student will be able to use the caulking gun in an efficient manner

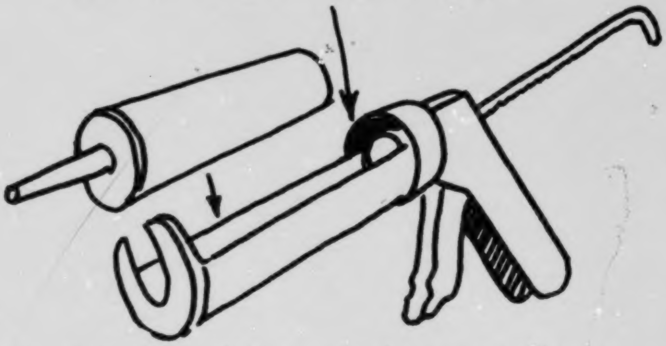
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Clip off end of caulking tube spout on a slight angle allowing for the size of hole needed.

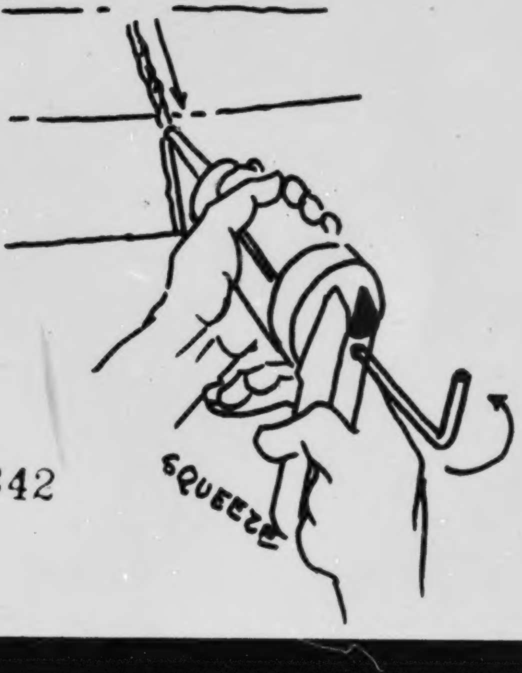
2. Reverse and pull back plunger handle on caulking gun.

3. Insert caulking tube cartridge with back end first into caulking gun.



4. Release caulking gun plunger handle so that the plunger ratchets forward when caulking gun trigger is squeezed.

5. Continue squeezing trigger to produce correct flow of sealer.



6. Release plunger handle when done.

OPERATION SHEET
SC-6-6

COMPETENCY: Level

COURSE: Sheet Metal

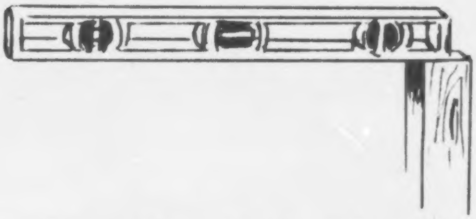
UNIT VI: Installation

OBJECTIVE: The student will be able to produce accurate, good-looking, first-class jobs

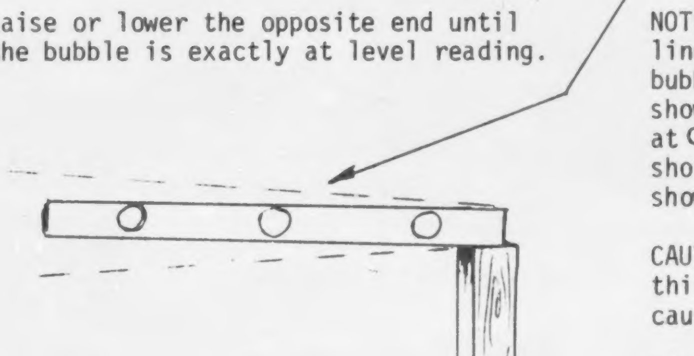
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

1. Locate point from which to level.
2. Place and hold the end of the level on the point previously established.

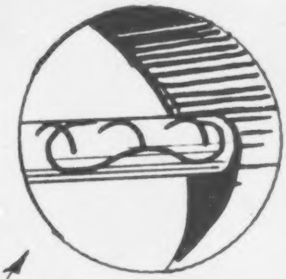


3. Raise or lower the opposite end until the bubble is exactly at level reading.



TEACHING/LEARNING ACTIVITIES

NOTE: Use only the best and most accurate level. Inaccurate tools are frequent causes of inaccurate work.



NOTE: Some levels have two lines |⊂⊃| of which the bubble should be centered as shown. Some have one line at ⊂|⊃ which the bubble should be centered as shown.

CAUTION: Do not drop or jar this instrument, it could cause it to become inaccurate.

NOTE: Always use as large a leveling tool as possible then reading will always be more accurate.

OPERATION SHEET
SC-6-7

COMPETENCY: Cut with a Sawzall

COURSE: Sheet Metal

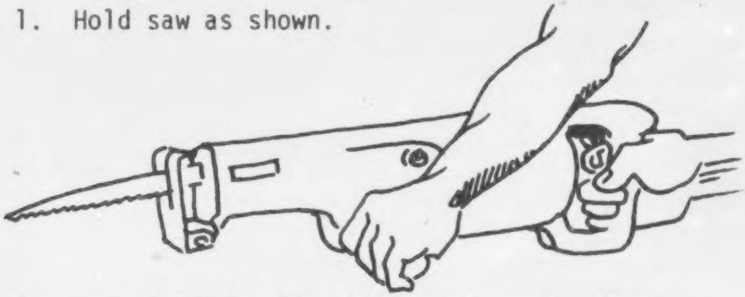
UNIT VI: Installation

OBJECTIVE: The student will be able to cut safely and accurately with the sawzall

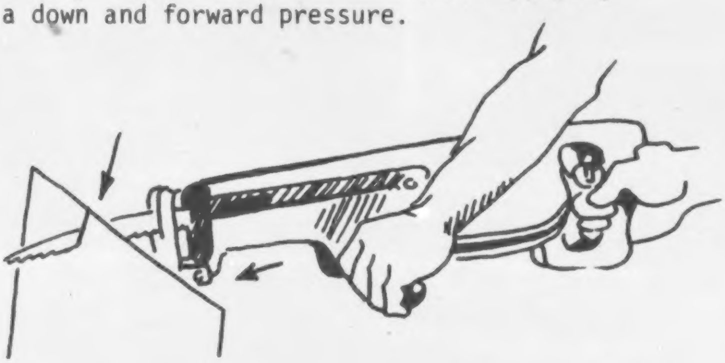
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Hold saw as shown.



2. Insert blade into hole cut in work piece or against edge as needed.
3. Make sure blade is clear of all wires or other obstructions while pulling trigger to start.
4. Slowly enter blade into cut while applying a down and forward pressure.



5. Shut off saw before removing from work.

OPERATION SHEET
SC-6-8

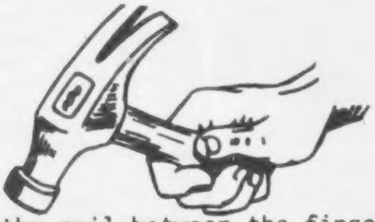
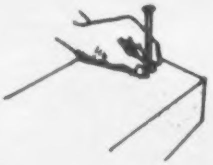
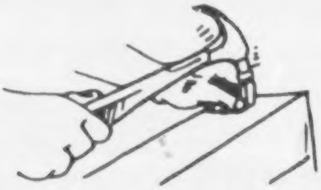
COMPETENCY: Drive Nails

COURSE: Sheet Metal

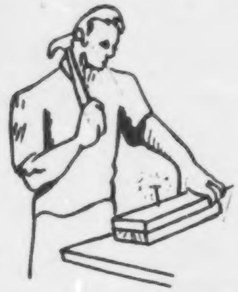
UNIT VI: Installation

OBJECTIVE: The student will be able to drive nails efficiently without damaging the work or the fingers

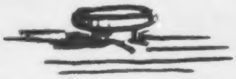
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold the hammer with fingers underneath and thumb alongside or on top of the handle. 	NOTE: Except for light blows, the handle is held close to the end.
2. Hold the nail between the fingers and thumb of other hand, using the rest of the hand to help position the nail. 	
3. Rest the face of the hammer on the head of the nail, raise the hammer slightly and give the nail a light tap. 	NOTE: This starts the nail and will help to set the aim of the nail.

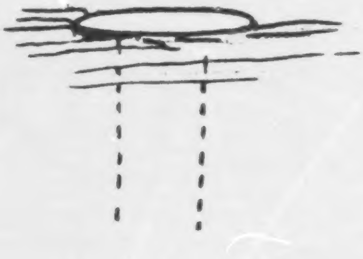
4. Line the hammer up so that the nail is struck squarely so as not to bend the nail or mar the wood.



5. Drive the nail until the head is almost level with the surface of the wood.



6. Finish driving the nail with light blows so as not to damage the surface of the wood.



OPERATION SHEET
SC-6-8A

COMPETENCY: Pull Nails

COURSE: Sheet Metal

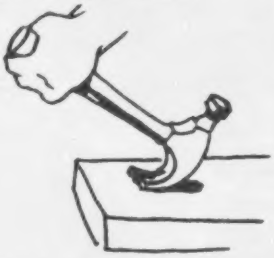
UNIT VI: Installation

OBJECTIVE: The student will be able to pull nails without breaking the handle out of the hammer

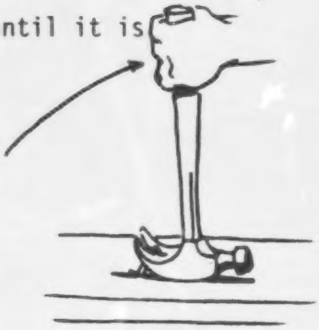
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

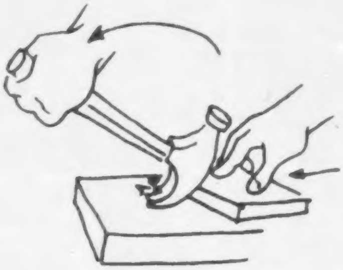
1. Set the claw of the hammer firmly under the head of the nail.



2. Pull the hammer handle until it is almost straight up.



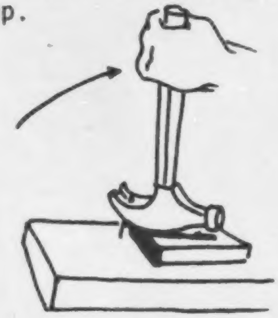
3. Tip the hammer handle forward so a block of scrap wood can be put under the head of the hammer.



COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

4. Draw up on the nail again until the nail is free or until the handle is again straight up.



NOTE: If the nail is not out, add a second block of wood and repeat step 4.

OPERATION SHEET
SC-6-9

COMPETENCY: Drive a Screw with an Electric Drill

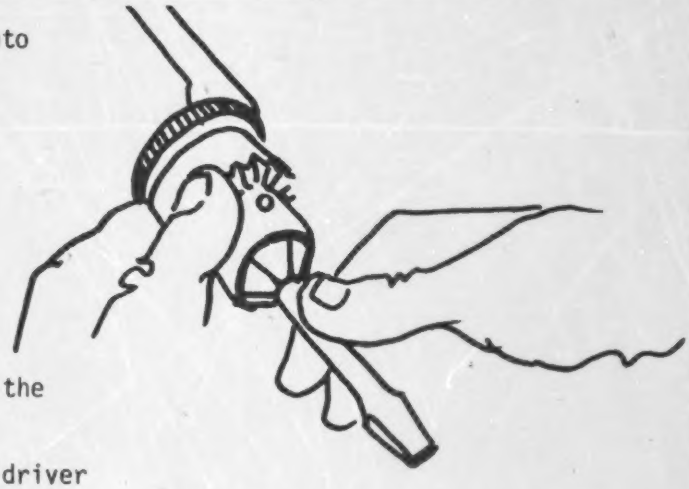
COURSE: Sheet Metal UNIT IV: Installation

OBJECTIVE: The student will be able to obtain the necessary touch and feel of setting screws with a power drill

Page 1 of 2 pages

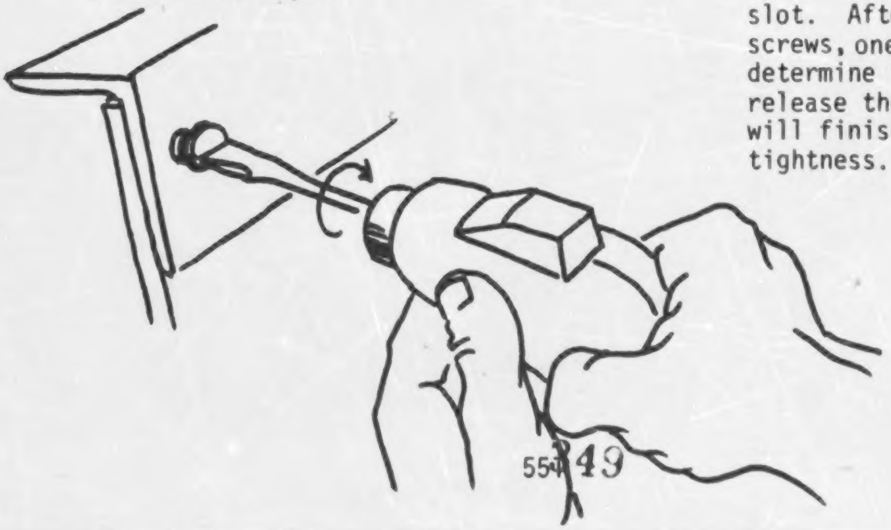
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

1. Insert screwdriver (flat blade) into drill chuck and securely tighten.



2. Place the blade of the driver into the slot of the prestarted screw.
3. Exert enough pressure on drill and driver to keep tip in slot.
4. Turn on the drill and run screw in until it is tight.

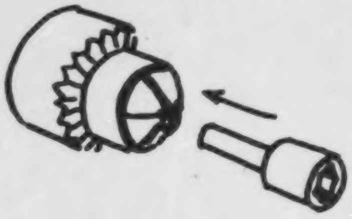
CAUTION: Do not permit the blade to hop out of the screw slot. After turning in several screws, one should be able to determine the exact time to release the power switch so screw will finish at just the correct tightness.



COMPETENCE - PROCEDURE/STEPS

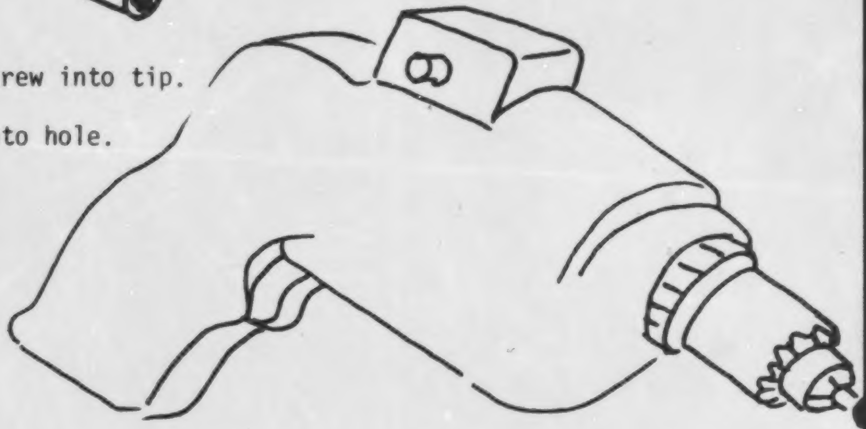
TEACHING/LEARNING ACTIVITIES

5. Remove flat blade tip and install magnetic hex tip into drill chuck.



6. Insert hex head screw into tip.

7. Place screw tip into hole.



8. Turn on drill and run screw in until it is tight.

NOTE: These type screws can be installed without a starting or predrilled hole.

OPERATION SHEET
SC-6-10

COMPETENCY: Mark a Long Line using a Chalk Line

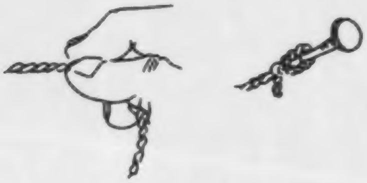
COURSE: Sheet Metal UNIT VI: Installation

OBJECTIVE: The student will be able to accurately and efficiently mark a long line with a chalkline

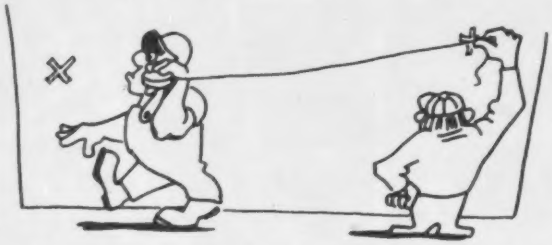
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

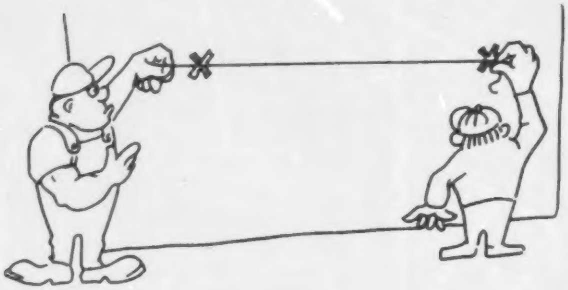
1. Attach loop at end of chalk line to a nail; or have someone hold the end of the line at the desired mark.



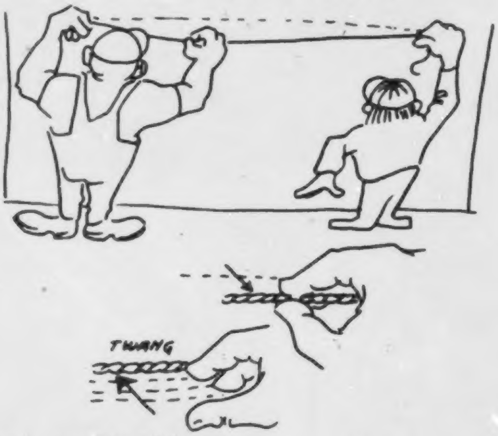
2. Pull line from the reel by walking away from the holding point.



3. When the desired distance has been reached, pull the line tight, passing line over the desired mark, press the line to the surface to be marked.



4. Using free hand, pull the line away from the surface and release the line allowing it to snap back to the surface.



5. Reel in the line.

OPERATION SHEET
SC-6-11

COMPETENCY: Take Outside Measurements

COURSE: Sheet Metal UNIT VI: Installation

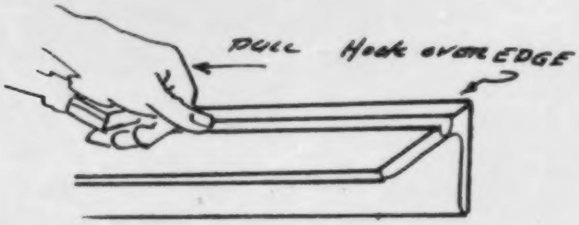
OBJECTIVE: The student will be able to accurately take outside measurements

Page 1 of 3 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

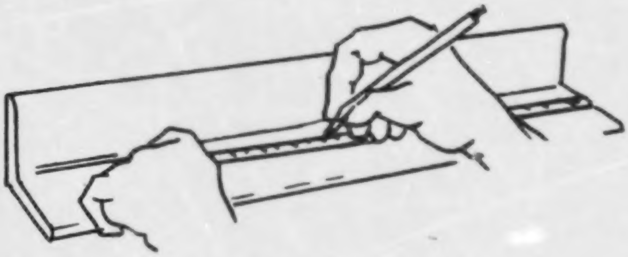
Take an outside measurement with a steel tape rule:

1. Hook the tape over the edge of the stock.



2. Pull the tape out far enough to make the measurement.

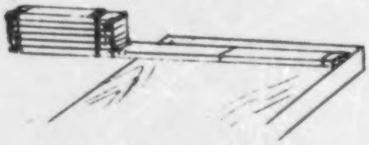
3. Read or mark the dimension.



4. Rewind the tape.

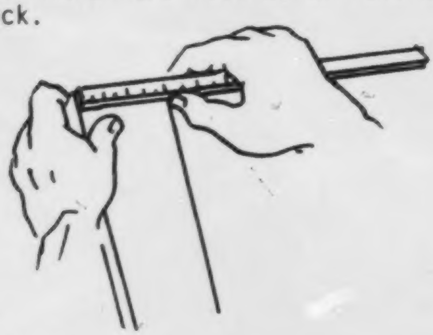
Take an outside measurement with a 6' folding wood rule:

1. Unfold the rule longer than the space to be measured.



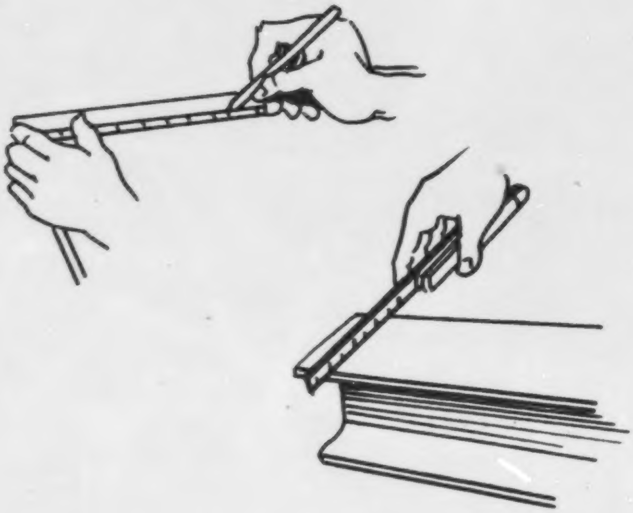
2. Hold the rule flat on the surface to be measured.

3. Hold the end of the rule at one end of the stock.



4. Read or mark the dimension.

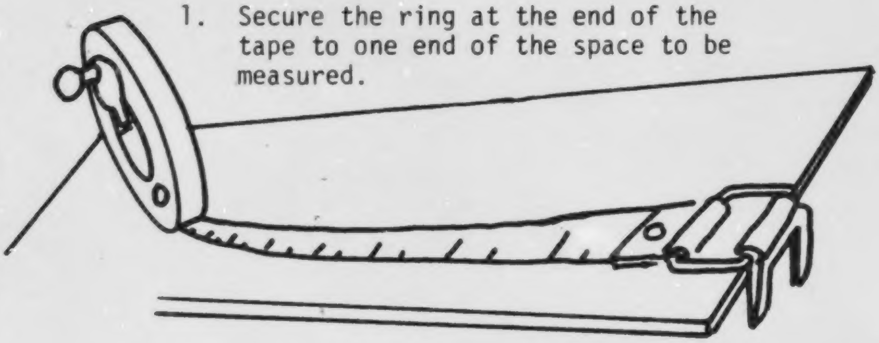
NOTE: To take a very accurate measurement, hold the edge of the rule against the surface of the object being measured. Thi will prevent errors resulting from the thickness of the rule.



5. Fold the rule.

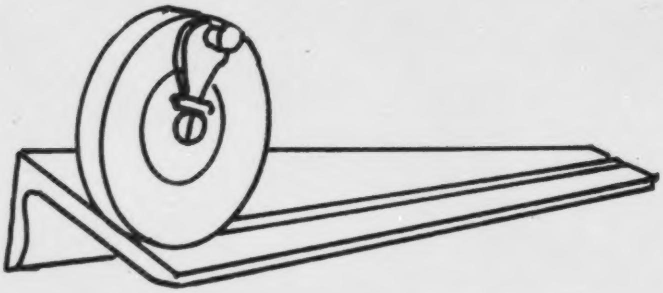
Take an outside measurement with a 50' or 100' steel tape:

1. Secure the ring at the end of the tape to one end of the space to be measured.



2. Unwind the tape along the space to be measured.

NOTE: Make sure that it lays flat and has no kinks in it.



3. Pull the tape tight to the other end of the space to be measured.
4. Read or mark the dimension.
5. Rewind the tape.

OPERATION SHEET
SC-6-12

COMPETENCY: Take Inside Measurements

COURSE: Sheet Metal

UNIT VI: Installation

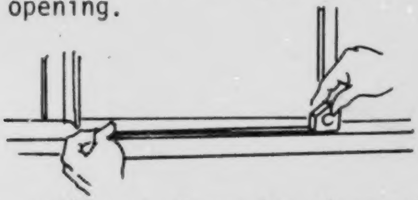
OBJECTIVE: The student will be able to accurately take inside measurements

Page 1 of 3 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES

Take an inside measurement with a steel tape:

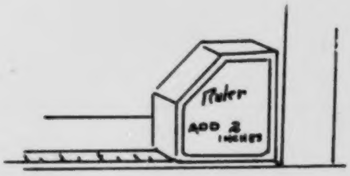
1. Hold the end of the tape against one side of the opening and draw the tape across the opening until the tape case butts against the opposite side of the opening.



2. Take a reading at the point where the tape enters the case.

3. Add the width of the tape case to the reading taken in step 2.

NOTE: Usually the width of the tape case is stamped right on it.

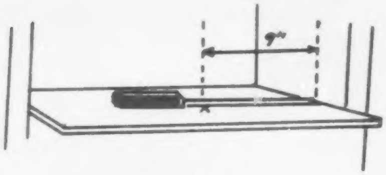


4. Rewind the tape.

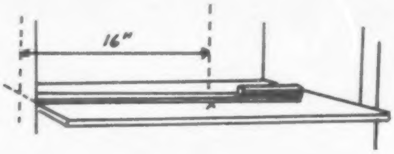
Take an inside measurement with a folding wood rule:

1. Unfold the rule as far as possible inside the opening.

2. Place the end of the rule against one side of the opening and make a small mark at a point which is at least half the distance being measured.



3. Reverse the rule in the opening and take a measurement from the opposite side to the mark.



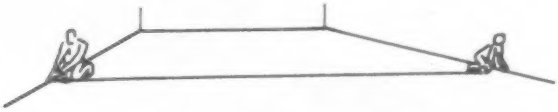
4. Add the two measurements to get the total.

9" + 16" = 25"

5. Refold the rule.

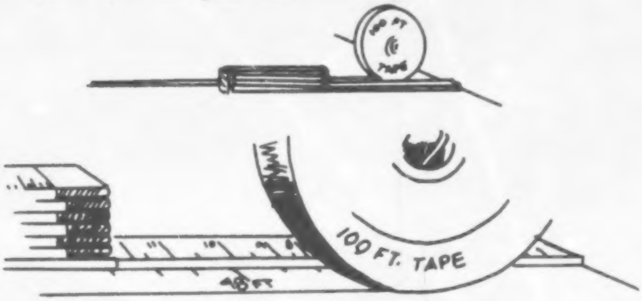
Take an inside measurement with a 100' steel tape:

1. Have a helper hold the end of the tape against one wall.
2. Unwind the tape to a point near the opposite wall.
3. Use a folding rule to measure from the foot mark nearest the tape case, to the wall.



NOTE: The mark, if possible, should be on a number such as 10, 20, 30, etc.

4. Add the foot measurement from the tape to the inch measurement from the rule to get the total.



5. Rewind the tape and refold the rule.

INFORMATION SHEET
IL-3-15

TITLE: Types, Use and Care of Hand Punches

COURSE: Sheet Metal UNIT III: Hand Tools and Machines

A hand punch consists of a die and a punch moved by levers. The punch forces the metal through the die leaving a clean hole. The die acts as a backing instead of the wood block or lead cake. Like solid punches, the hand punch is used for punching small holes in light sheet metal. It is quicker but can be used only when the holes are to be punched near the edge of the sheet.

There are several different types of hand punches, the arrangement of the levers and the method for changing the punches and the dies differ, but the general principle of operation remains the same.

The punches and dies of the hand punch are made of tool steel, hardened and ground, and are removable. The punch has a shoulder which fits into a collar in the type of hand punch for punching round holes. This collar is threaded and is fastened to the punching lever. At the lower end of the punch is a center point which is used for locating the center of the hole to be punched. The die is threaded and has a slot in the lower end to facilitate changing it. Clearance is provided inside the die to allow the punched material to fall through freely. The depth of the throat governs the distance from the edge of the hole to be punched.

ASSIGNMENT SHEET
AS-3-15

TITLE: Hand Punches UNIT III: Hand Tools and Machines

COURSE: Sheet Metal

TEXT/REFERENCE: Delmar, "Hand Processes"

ASSIGNMENT: Carefully study the reference (pp. 95-99) and write the answers to the following questions.

1. Under what conditions is a hand punch used?
2. What is the maximum gage of sheet metal that can be punched with a hand punch?
3. Draw a sketch of a punch and die and label the punch, the centering point and the die.
4. How far from the edge of the sheet can a hole be punched with a hand punch?
5. What are the maximum and minimum sizes of holes which can be punched with a hand punch?